California Earthquake Loss Reduction Plan

1997–2001

The California Seismic Safety Commission

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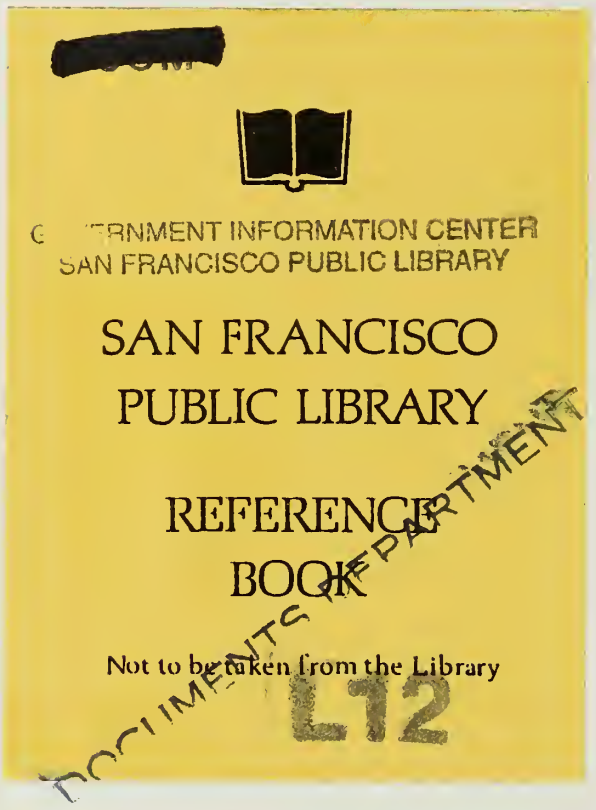
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California Earthquake Loss Reduction Plan

1997–2001

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SSC 97-02

Publishing Information

The *California Earthquake Loss Reduction Plan* was developed by the California Seismic Safety Commission in fulfillment of a mandate enacted by the Legislature in the California Earthquake Hazards Reduction Act of 1986 (*Government Code* Section 8870 et. seq.). The document was prepared for photo-offset production by the staff of the Publications Division, California Department of Education, working with Linda Townsdin, project coordinator for the commission. (See Acknowledgments, p. vii, for a full list of contributors.) It was edited for publication by Sally Wetterholm Smith. The original cover design and interior layout were prepared by Paul Lee, and Cheryl Shawver McDonald completed the formatting. Typesetting was done by Jeannette Huff. The *California Earthquake Loss Reduction Plan* was distributed under the provisions of the Library Distribution Act and *Government Code* Section 11096.

In addition to this document, the California Seismic Safety Commission publishes a variety of documents related to earthquakes and earthquake safety. To obtain a publications list with prices and ordering information, interested persons may contact the commission's office or visit its Web site.

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REF 363.3495 C128

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GOVERNOR PETE WILSON

Dear Concerned Citizen:

Today in California there is an unacceptable level of risk created by the increasing frequency and magnitude of earthquakes coupled with a growing population. It is important for you to know that the State of California is committed to an aggressive earthquake loss reduction policy.

No one can prevent earthquakes nor can they be accurately predicted. However, through the *California Earthquake Loss Reduction Plan*, we can significantly reduce the loss of life and property and work to speed up recovery.

The plan focuses on improving the way in which we learn about, build for, and live with earthquakes, through proper use of mitigation. This action will ensure that the lives and properties of the citizens of California will be made more safe from potentially devastating earthquakes.

Sincerely,

Pete Wilson

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Acknowledgments

The California Seismic Safety Commission wishes to thank the Governor's Office of Emergency Services for granting matching funds from the National Earthquake Hazards Reduction Program (NEHRP) to produce the *California Earthquake Loss Reduction Plan*. This document could not have been produced without Federal Emergency Management Agency agreement EMF-96PA0598.

The commission also thanks Harry C. Hallenbeck, FAIA, whose expertise and dedication were invaluable in preparing this plan. He spent countless hours with experts throughout the state who share the commission's goal of working toward a safer California. His skilled leadership and creative vision are deeply appreciated.

Special thanks are also extended to Commissioner Pat Snyder, chair, and the members of the California at Risk Committee for their generous commitment of time and untiring enthusiasm in producing the *California Earthquake Loss Reduction Plan*.

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Executive Summary

California's Seismic Safety Commission was established by legislation in January 1975 to set goals and priorities for earthquake safety. The *California Earthquake Loss Reduction Plan* of 1997 is a comprehensive strategic plan that sets forth statewide policy and direction in pursuit of the vision for a safer California.

The earthquake policy process began in 1974 with the publication of the *Final Report* by the Joint Legislative Committee on Seismic Safety. That report identified the basic need for continuing efforts to mitigate earthquake risks and spawned the establishment of the commission. Since then, periodic strategic plans, formerly known as *California at Risk,* and numerous reports have been published to fulfill the commission's mandate.

This version of the strategic plan satisfies three needs:

- It continues to be the commission's policy statement about what needs to be done to reduce earthquake risk over the long term.
- It guides the executive branch in its overall implementation strategies and priorities for seismic safety.
- It complies with the Federal Emergency Management Agency's (FEMA) *National Hazards Mitigation Strategy* and is the state's hazard mitigation plan required for federal mitigation funding after an earthquake.

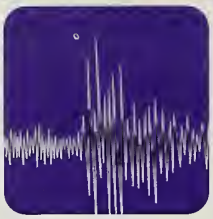
This is a living document that will be reviewed and revised on an annual basis. It projects the commission's vision to the year 2010, in conformance with the *National Hazards Mitigation Strategy,* while undergoing a continuous process of evaluation that will refine the direction and measure the results.

Simply put, the plan is a matrix of eleven elements. Each element addresses a distinct but interrelated area of concern, and each supports and is supported by the others. Forty-four strategies of equal importance are stated in the plan. A total of 120 initiatives each identify a new or renewed effort to provide direction for implementation. Nineteen of the initiatives are considered critically important and should be implemented as having the highest priority. Implementation of the initiatives will be developed by the Administration, the Legislature, and others responsible for earthquake safety. Individual implementation plans will describe the actions and costs required to accomplish the intent of the initiatives.

California has already made significant progress toward earthquake safety; with continued commitment, the objectives can be reached by the year 2010. The focus for our efforts is clear. Mitigation works! Loss reduction is possible and practical.

The Plan Matrix

Learning About Earthquakes



	Geosciences	Research and Technology	Education and Information	Economics	Land Use
Concerns	Insufficient use of current geologic knowledge	Insufficient technical knowledge	Insufficiently educated and informed citizenry	Unacceptable economic losses	Seismic hazards not incorporated in general plans
Objective(s)	Full application of geosciences	Sustained research, effective transfer of technology	Increased knowledge to make effective decisions	Shift of design and construction policies to economic value basis	Balance between growth and seismic hazards
Strategies	Improve use of current geologic knowledge	Establish program for risk reduction	Promote competency of professionals	Demonstrate cost-effectiveness	Incorporate seismic hazards data in general plans
	Apply consistent geologic standards	Ensure applicability to risk reduction	Increase public awareness	Develop incentives and remove barriers	Strengthen the California Environmental Quality Act (CEQA) process
	Show cost-effectiveness	Demonstrate benefit of research to performance	Inform public officials	Include property protection in building codes	Develop mitigation techniques
	Support ongoing research	Coordinate existing research activities	Establish K–12 earthquake program	Protect functionality of infrastructure	Protect areas from inundation
Benefits	Better performance to reduce losses	Greater levels of risk reduction	Better educated policy makers and professionals	Improved economic viability and reduced tax impact	Avoidance of negative impact on planning goals
Responsibilities	State is prime motivator; local entities are enforcers.	State to operate the program.	State is prime motivator; local entities are enforcers.	State is prime leader; all levels participate.	State to develop data; local entities to implement; owners to use.
Costs	State = ongoing Local = minimal User = < 2 percent	State = minimal Local = none User = varies	State = minimal Local = none User = negligible	State = minimal Local = minimal User = varies	State = minimal Local = varies Owner = minimal
Incentives	Building and zoning trade-offs, insurance rates, tax benefits	Reduced insurance rates, tax benefits	Strong state policy, public demand	Strong state policy, public demand	Zoning trade-offs, density rights, transfers, etc.

Building for Earthquakes			Living with Earthquakes		
Existing Buildings	**New Construction**	**Utilities and Transportation**	**Preparedness**	**Emergency Response**	**Recovery**
Property protection deficiencies in buildings	Unacceptable levels of personal and economic impact	Catastrophic personal and economic loss	Insufficient understanding and action	Insufficient responsive and sustainable systems	Impairments to effective and speedy recovery
Upgrade of vulnerable buildings to acceptable performance levels	Increased life, property, and economic safety	Protect life, limit property damage, resume function	Increased understanding and ability to act	Improved communications and medical response	Statewide recovery plan and implementation
Provide incentives to retrofit	Include all new construction	Ensure performance standards	Increase understanding of potential impact	Improve communications	Establish a statewide recovery plan
Initiate broad educational efforts	Develop integrated approach to seismic design	Understand and minimize secondary effects	Develop comprehensive cost-effective approach	Improve medical response	Improve interim and long-term housing
Develop effective methodologies	Adopt California-specific standards	Evaluate and prioritize mitigation	Increase the desire and ability to act	Improve search and rescue	Streamline permitting and rebuilding process
Upgrade vulnerable buildings and other structures	Do performance-focused research	Retrofit critical systems	Improve K–12 school preparedness	Improve data collection and dissemination	Ensure accurate and timely information
Significant reduction in loss of life and costs	Improved life-safety, reduced economic impact	Economic viability of the region and state	Minimized personal losses	Preservation of lives and property	Minimized economic disaster
State is prime motivator; all levels participate.	State must enforce plan for its own properties.	State is the lead; each system owner must participate.	State provides leadership; individual entities implement.	State provides facilities, equipment, and training.	State provides leadership; local entities implement.
State = minimal Local = minimal User = varies	State = minimal Local = minimal User = < 2 percent	State = minimal Local = none Utility = varies	State = minimal Local = minimal User = minimal	State = considerable Local = minimal User = negligible	State = considerable Local = minimal User = negligible
Economic and regulatory	Economic and regulatory	Economic and regulatory	Strong state policy, public demand	Strong state policy, public demand	Strong state policy, public demand

The Vision

More than 80 destructive earthquakes rated at magnitude 5.0 or higher on the Richter Scale have been recorded in California since the early 1800s. The last ten years alone have seen at least five damaging earthquakes ranging in magnitude from 5.9 to 7.3. These earthquakes were considered of "moderate" size, and fortunately they occurred during nonworking hours. Even with such good fortune, however, the resulting devastation clearly demonstrated the need for continued efforts to reduce loss and speed recovery.

Natural hazards exist everywhere, and California is no exception. Throughout its history, the state has experienced floods, tsunamis, wildfires, droughts, landslides, volcanoes, windstorms, and earthquakes. But of all these natural disasters, earthquakes pose the greatest threat to the lives, property, and economy of California. Hard facts cannot be ignored:

- According to the U.S. Geological Survey, there continues to be a "90-percent chance that at least one major earthquake will strike an urban area in California in the next 30 years."
- Two recent earthquakes, Loma Prieta in 1989 and Northridge in 1994, caused over 100 deaths and more than $100 billion in reported damage and indirect losses. In the Northridge earthquake alone, up to 125,000 people were made homeless, and 82,000 residential and commercial structures (of which 60,000 were multifamily residential units) and 5,400 mobile homes were damaged or destroyed.[1]
- The majority of California's population lives within 20 miles of a major earthquake fault. According to the Federal Emergency Management Agency's (FEMA) *National Hazards Mitigation Strategy* (December 1995), the population at risk due to earthquakes will dramatically increase by the year 2010. New homes, communities, and infrastructure will develop to accommodate the population growth, and the risk of human and economic loss from earthquakes will rise accordingly.

The increasing frequency and magnitude of earthquakes plus the effects of a growing population create unacceptable levels of risk. Therefore, the State of California is committed to an aggressive earthquake loss reduction policy.

No one can prevent earthquakes nor accurately predict them, but through the *California Earthquake Loss Reduction Plan*, loss of life and property can be significantly reduced.

The California Earthquake Hazards Reduction Act

(*Government Code* Chapter 12, Section 8870 et seq.)

The California Earthquake Hazards Reduction Act was authored by Senators Alquist and Campbell and signed into law by Governor Deukmejian on October 2, 1985. The statute requires the Seismic Safety Commission to prepare and administer a program setting forth priorities, funding sources, amounts, schedules, and other resources needed to reduce statewide earthquake hazards significantly by the year 2000.

[1] *The Northridge Earthquake of January 17, 1994: Report of Data Collection and Analysis Prepared by the Geographic Information Systems Group of the Governor's Office of Emergency Services.* Sacramento, 1994.

Evolution of the Plan

Earthquake loss reduction may be defined as sustained action to reduce or eliminate long-term risk to human life, property, and the economy from earthquakes.

In 1986, the California Earthquake Hazards Reduction Act directed California's Seismic Safety Commission to establish a series of multiyear programs to significantly reduce earthquake risk. The first version of the program, known as *California at Risk*, became the state's official earthquake hazard reduction plan for 1987–92. The second version (the plan for 1992–96) built on the first, adding significant new data and initiatives for action. This version addresses the period from 1997 to 2001. The first two versions have served well as a catalyst for legislation and significant accomplishments in the areas of identifying seismic hazards and improving the safety of hospitals, homes, mobile homes, transportation, and infrastructures.

After the Loma Prieta earthquake, FEMA required the state to provide an earthquake hazard reduction plan to establish eligibility for mitigation funding. *California at Risk* was recognized as the state's earthquake mitigation plan. The plan has evolved into a multiuse document, serving state agencies, local governments, schools, businesses, volunteer and other private nonprofit agencies, and individuals. It presents broad objectives and recommends strategies for achieving them by the year 2010. Responsibility for implementing and accomplishing the objectives rests with individuals, private businesses, and appropriate agencies.

FEMA's *National Hazards Mitigation Strategy* emphasizes partnerships among all levels of government and the private sector. These alliances form the foundation of the plan to empower all Americans to fulfill their responsibility for ensuring safer communities. The *California Earthquake Loss Reduction Plan* acknowledges the state's commitment to this multilevel partnership. Included in that partnership are government agencies (federal, state, and local) that carry out seismic safety activities, academic institutions, the private sector, and volunteer organizations.

California has learned important lessons from its earthquakes. By continuing to support new and ongoing efforts to protect its people and the built environment, the state can be more effective in reducing damage and injury from succeeding earthquakes. California's effective reduction of its seismic risk will ensure environmental and economic viability for the lives of Californians.

Great strides have been taken in protecting the lives, property, and economy of Californians from earthquakes. Although progress to date has been good, there is much more that must be done if the vision of a safer California is to become a reality.

The Vision

The lives and properties of the citizens of California are being made safer from potentially devastating earthquakes by the implementation of an effective, long-term seismic safety policy that has the following as its basic principles:

- Continual advancement in education and science about earthquakes and techniques for mitigating their effects
- Evolutionary advancement in public policy affecting the design, construction, and retrofit of California's built environment
- Effective preparedness, immediate emergency response, and successful personal and economic recovery

The Goals by the Year 2010

To achieve the vision, the *California Earthquake Loss Reduction Plan* presents three basic goals to be accomplished by the year 2010:

Advancement in Learning About Earthquakes

Applicable and effective research in geoscience, engineering, and social sciences about earthquakes, including techniques for mitigating their effects, will be the basis of California's mitigation strategies. The full spectrum of educational opportunities and communication strategies will effectively transfer that knowledge to the policy makers, the professions, and the public.

Advancement in Building for Earthquakes

Public policy affecting the design and retrofit of vulnerable existing structures will encourage cost-effective mitigation. The design and construction of all new structures will be based on higher performance standards that increase reliable levels of protection for both the lives and property of its citizens, and will ensure continued strength in the California economy.

Advancement in Living with Earthquakes

Preparedness and emergency response systems will effectively minimize the pain and suffering from potentially disastrous earthquakes. Both short- and long-term efforts to accomplish personal and economic recovery will significantly reduce the impact. Californians will be better prepared to understand, respond, and recover.

The Perspective

The *California Earthquake Loss Reduction Plan* continues both a never ending quest for safety from the hazards of earthquakes and the state's goal-setting policy. The process began in 1974 with the publication of the *Final Report* of the Joint Legislative Committee on Seismic Safety, which was established after the 1969 Santa Rosa earthquake. The *Report* summarized the history of early seismic safety policy and the achievements of the joint committee during its existence from 1970 to 1974. It also made several recommendations, principal of which was the creation of the Seismic Safety Commission.

Commission Established

The Seismic Safety Commission was established by legislation that took effect on January 1, 1975. The legislation directed the commission to engage in the following activities:

- Set goals and priorities in the public and private sectors.
- Request state agencies to devise criteria to promote earthquake and disaster safety.
- Recommend changes in programs to state agencies, local agencies, and the private sector to further seismic safety.
- Encourage research.
- Help coordinate the earthquake safety activities of government at all levels.

Within hours of their doors being opened in Sacramento on August 1, 1975, the commission's offices were shaken by the nearby Oroville earthquake. Since then, the commission has investigated virtually every damaging California earthquake in its continuing quest for seismic safety.

Soon after its establishment, the commission inaugurated a process for updating the joint committee's report to keep the seismic safety vision alive.

The First Report

From its beginning the commission recognized that adoption and implementation of its recommendations were critical to successfully reducing earthquake risk.

The commission's first report, *Goals and Policies for Earthquake Safety in California*, was published in 1979. The report reemphasized many of the joint committee's recommendations and added others. It focused on several common but key subject areas: the roles of governments, private sector, and the professions; land use, especially general plan implementation by local governments; and improved standards for new construction, including enforcement and quality control. The report also addressed locating, designing, constructing, and operating critical facilities and lifeline systems; dealing with existing hazardous buildings; strengthening preparedness and response capabilities; guiding earthquake recovery; and promoting earthquake information, education and training. In addition, the report contained recommendations on financing seismic safety programs, dealing with earthquake prediction, and defining and supporting needed research.

The 1279 Report

Senate Bill 1279 of 1978 laid the foundation for California's strategic planning process. This legislation followed two significant earthquakes in China that had been predicted by the People's Seismological Bureau, based on a series of increasingly strong foreshocks. Those events were a damaging earthquake in Haicheng in 1975 and a

devastating earthquake in Tangshan in 1976. SB 1279 directed the commission to assess the policy and program implications of earthquake prediction and to develop a strategic seismic safety program and financing plan for California. The resulting report, *Earthquake Hazards Management: An Action Plan for California,* was published in 1982. In addition to reflecting the commission's own thinking, the report reiterated the recommendations of a subcommittee of the Assembly Committee on Government Organization and a Governor's Task Force on Earthquake Preparedness. Commonly known as the 1279 Report, it recommended a five-year, $721 million improvement program to support major new initiatives.

Strategic Planning

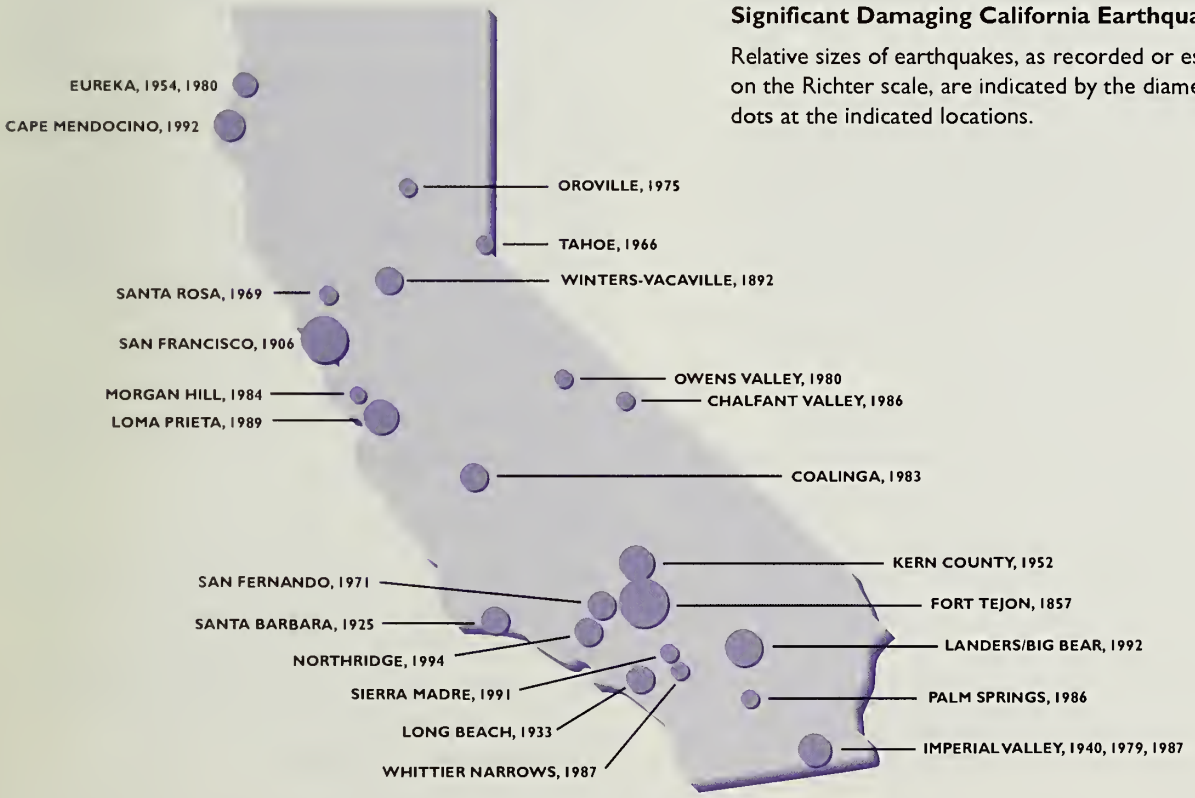
Because of its desire to maintain the momentum of a goal- and policy-setting process, the commission sponsored the California Earthquake Hazard Reduction Act of 1986. Enactment followed the devastating Mexico City earthquake of 1985, which brought home the specter of massive urban losses. The legislation was passed by the Legislature, signed by Governor Deukmejian, and became effective January 1, 1986, officially launching the commission's strategic planning. Its goal was simple:

To significantly reduce statewide seismic hazards by the end of the century

The commission was assigned the tasks of preparing and administering the program, which included setting priorities, finding funding sources, establishing amounts, and dealing with schedules and other resources. Implementation of the program involves over 40 state agencies that share responsibilities for seismic safety.

Significant Damaging California Earthquakes

Relative sizes of earthquakes, as recorded or estimated on the Richter scale, are indicated by the diameter of the dots at the indicated locations.



Sources: *California Geology*, California Department of Conservation, 1986; *Earthquake History of the U.S.*, U.S. Departments of Commerce and Interior, 1982; records of California Office of Emergency Services; compiled and revised by California Seismic Safety Commission, 1996.

The program was built around the concept of a regular series of five-year plans with annual program reports. The first document, known as *California at Risk,* was published for 1987–92. It contained 70 new initiatives. The second version covered the 1992–96 period. That version reduced the number of initiatives to 42 in the following categories: Existing Vulnerable Facilities, New Facilities, Emergency Response Management, Disaster Recovery, and Research and Information/ Education.

The commission assessed implementation by publishing intervening status reports. Each report contains comments on what has been achieved, what has been delayed, and what remains to be initiated. Many lessons have been learned and relearned from earthquakes that have occurred since 1986. Those events include the damaging earthquakes that occurred in 1987 at Whittier Narrows, in 1989 at Loma Prieta, and in 1994 at Northridge. The resulting data have been incorporated by the commission into its strategic planning process.

The 1997 Version

This version of the strategic plan continues a thinking and planning process that began over 20 years ago. Although the commission has taken an appropriate new look and somewhat different emphasis, it has done so with a continued commitment to the original goals and the intent that the document serve multiple purposes:

- First, it continues to be the commission's policy statement about what needs to be done to reduce earthquake risk over the long term;
- Second, it is the state's strategic plan guiding the California Executive Branch agencies in their overall implementation strategies and priorities for seismic safety; and
- Third, it complies with the *National Hazards Mitigation Strategy* and serves as the state's federally required hazard mitigation plan for earthquakes.

In 1996 Governor Wilson established the position of Director of Seismic Safety Implementation within the State and Consumer Services Agency. This position heads the department responsible for coordinating the activities of the Administration that relate to seismic safety, including working with the commission to translate its recommended policies into implementable actions. This new position reinforces the Governor's commitment to earthquake loss reduction and has helped shape the substance of this document.

Although formats, styles, priorities, and other elements have changed over the years, the strategic planning approach has produced several long-term accomplishments:

- The commission has maintained a legislatively required process to define and recommend broad safety policy goals, priorities, and means of implementation.
- The process has influenced the scope and direction of many programs and provided an "agenda-in-waiting" of recommended actions to be proposed when opportunities arise.
- The process has provided a framework for defining the commission's regular legislative program and for supporting or opposing relevant legislation proposed by others.
- The process has served the broader earthquake constituency by providing an acceptable, policy-oriented, state-level strategic plan.
- The process has provided specific recommendations supporting individual agencies' statutory bases and program operations.
- The process has helped the commission and others review and evaluate accomplishments as well as identify remaining seismic safety needs.
- The resulting document is serving as California's qualified and required mitigation plan for earthquakes, helping eligible state and local agencies and other organizations receive about $1 billion in federal mitigation grant funds awarded after the 1994 Northridge earthquake.

The *California Earthquake Loss Reduction Plan,* like all of its predecessors, is dedicated to the continuing quest of reducing loss and speeding recovery.

The Plan

The *California Earthquake Loss Reduction Plan* sets forth basic government policy and direction in pursuit of the vision for a safer California.

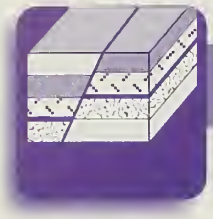
Mitigation works! Loss reduction is possible and practical. Significant progress has already been made, and with continued commitment, the objectives can be reached by the year 2010.

The plan rests on the fact that increased levels of seismic performance—through the upgrading of existing vulnerable structures, better design of new construction, and increased preparedness in all areas—provide the most cost-effective method to reduce loss and improve recovery from earthquakes.

The plan is a road map to achieve a safer California. It contains 11 elements, each addressing a distinct but interrelated area of concern. The plan sets forth statewide objectives and strategies to support the goals. Each element is both a stand-alone avenue to pursue improved levels of risk reduction and preparedness for that particular element and a cross street interconnected with the other elements. As such, the plan is a matrix, with each element supporting and being supported by the others. The goals, objectives, and strategies presented address the state's most pressing seismic issues.

Each element is of equal importance in the quest for a safer California, and each is considered an indispensable part of the plan. The elements are not intended as a listing of detailed action items, but rather a presentation of broad policy and direction from which agencies at all levels of government can be guided. Individual one-page policy statements for each element follow.

More detailed actions that support the plan are presented in "The Initiatives" and provide refinement to the overall plan of action. Ultimately, it is the responsibility of each agency and individual to ensure that their actions fulfill the intent of the plan.



Geosciences

Effective land-use planning and design must recognize the geologic environment and identify earthquake hazards. Every major earthquake yields new geologic data. Planning, design, and construction are not fully incorporating this new knowledge, however. Most advances have been motivated by reaction to disasters rather than good risk reduction strategies based on current and proved geologic knowledge.

Objectives

To continue to improve the structural performance of buildings and utility and transportation systems through effective use of current geologic knowledge

To ensure consistent application of that knowledge and to continuously improve risk reduction strategies based on application of the most current knowledge available

Strategies

Improve use of current geologic knowledge

By the year 2010, require that the most up-to-date and appropriate geologic knowledge be used as the basis for seismic risk reduction policy and application in land-use planning, building codes, and design standards.

Apply consistent geologic standards

By the year 2000, require that consistent statewide methods based on geologic knowledge and quality standards for seismic and fault rupture risk reduction be used as basic elements of land-use planning, building codes, design, construction quality control, and enforcement. Ensure that geologic knowledge is infused in all phases of the process.

Show cost-effectiveness

By the year 2000, demonstrate the value of using geologic information to reduce seismic losses within the built environment, particularly for identifying site-specific hazards for which project-specific, risk reduction measures will have a high benefit-to-cost ratio.

Support ongoing research

By the year 2000, establish a system for encouraging and applying the research and knowledge available from research institutions and entities as a fundamental part of the state's seismic risk reduction policy. Geologic knowledge should be the basis of the state's public policy on seismic risk reduction.

Benefits

Better use of geoscientific knowledge will enable professionals to improve planning and design to achieve higher levels of performance and ensure reduced losses.

Responsibilities

The state should take the lead in motivating and coordinating the application of knowledge developed by the geologic community and the strategies outlined. Local agencies will be responsible for implementation and enforcement.

Costs

Cost to the state for seismic hazard mapping will be ongoing. Urban areas have been assigned first priority. Cost to local governments will be minimal; their roles will be primarily those of policy administrators. Cost to the public will average less than 1 percent of the value of structures in most areas of the state and less than 5 percent in high seismicity areas. Even a cost average as low as 2 percent of the value is possible if proper, cost-effective design solutions are incorporated.

Incentives

Incentives may include zoning and building code options, reduced insurance rates, and tax policies that reflect the value of the improved seismic engineering.

Research and Technology

Design professionals still do not have the full knowledge necessary to design seismic-resistant structures reliably and economically. Several factors have contributed to this lack: 1) financial support for research has not kept pace with the need; 2) research priorities have been dictated by national priorities and funding rather than by California-specific needs; 3) the time lag between the development and application of new technologies is too long; and 4) lack of understanding exists concerning the applicability of research-based technology. Design professionals continue to rely on code-based prescriptive minimums.

Objectives

To develop and sustain a research program focused on the effects of seismic forces and their impact on structures and systems

To ensure an effective distribution of technological information to policy makers

Strategies

Establish program for risk reduction

By the year 1999, establish the criteria for a new California Program for Earthquake Risk Reduction as the primary entity for managing state-sponsored, problem-focused research as outlined in the Seismic Safety Commission's Research and Implementation Plan (1994).

Ensure applicability to risk reduction

By the year 2000, ensure applicability and value of seismic research to risk reduction by involving end users in the process, testing and evaluating large-scale components and systems, and encouraging feedback on in-place performance.

Demonstrate benefit of research to performance

By the year 2000, demonstrate the linkage between research and performance with examples such as tilt-up structures, base isolation, eccentric-braced steel frame structures, potential failure of dams, earthquake probabilities, and land-use techniques.

Coordinate existing research activities

By the year 2000, coordinate ongoing federal, state, and industrial earthquake research activities to ensure that California earthquake risk reduction priorities are being adequately addressed.

Benefits

Cost-effective techniques will be used to 1) retrofit existing structures so that lives can be saved; and 2) design new construction so that both lives and property can be protected.

Responsibilities

The state is responsible for creating and operating the risk reduction program; universities and private research institutions, local agencies, building code officials, industry, corporations, and the professional communities will also be involved in the process.

Costs

The risk reduction program will establish the program, any costs, and funding source. Cost to local agencies and design professionals will be negligible. Cost to end users will vary; large entities may share in the cost since they will benefit significantly. Cost to small entities will be negligible.

Incentives

Incentives for using advanced performance technology may include reduced insurance rates and tax policies that reflect the value of improved seismic performance without penalizing users.

Education and Information

Neither policy makers, professionals, nor private citizens have been adequately prepared for making knowledgable decisions about reducing seismic risk. A proactive education program is needed to replace reactive and inconsistent dissemination of information after an earthquake.

Objective

To initiate a comprehensive education strategy for sharing information (knowledge transfer) that will increase the knowledge of policy makers, professionals, and members of the public, enabling them to make effective decisions about reducing losses from earthquakes

Strategies

Promote competency of professionals

By the year 2000, the requirement will be in place for all professionals and others involved in the design and construction of the built environment to demonstrate competency in seismic design as a licensing and re-licensing requirement. Higher education systems and technical professions should provide appropriate educational programs to develop and maintain that competency.

Increase public awareness

By the year 2000: 1) develop an effective system for communicating information about the overall impact of earthquakes and loss reduction strategies to the general public; 2) convey demonstrated strategies for cost-effectiveness and incentives aimed at reducing losses; and 3) use informed media and other sources to promote and disseminate accurate information on a continual basis.

Inform public officials

By the year 2000, develop an effective system for communicating information about seismic risk and loss reduction strategies, including demonstrated approaches to cost effectiveness, to public officials at all governmental levels.

Establish K–12 earthquake program

By the year 2005, K–12 public and private schools should implement a program to integrate effective earthquake education within existing curricula and provide teacher training and develop materials that address earthquake science, school preparedness, and individual safety.

Benefits

Public officials will become better educated and informed, design professionals more capable, and public support stronger.

Responsibilities

Responsibility rests primarily at the state level, with other public- and private-sector involvement in much of the implementation. The state should take the lead in motivating and coordinating the strategies outlined and should place a high priority on initiating programs to educate and inform. Local governments are responsible for quality control and code enforcement.

Costs

Because the state's role is one of motivating, setting policy, and directing, cost to the state will be minimal. Cost to educational systems and other implementing agencies will be negligible because the strategies suggest redirecting resources within existing programs rather than instituting new programs. Cost to the professional, for additional educational tuition, will be minimal and will be offset by increased capability and marketability. Cost to the public will be negligible.

Incentives

Achieving the objectives of this element will depend on its place in state policy in the overall risk reduction plan. Although reducing seismic risk has tangible economic benefits and a better educated and informed citizenry will greatly increase the state's risk reduction efforts, direct financial incentives do not apply to this element.

Economics

With respect to earthquakes, building codes, design, and construction have been driven by life-safety standards. This approach has provided a high degree of life safety, but the preservation of property and the impact on economic value have been largely ignored. Recent earthquakes have caused unacceptable economic losses that could have been significantly reduced if the state had had an effective property protection policy as part of its comprehensive plan for earthquake loss reduction.

Objectives

To emphasize policies in design and construction and practices to protect property, contents, and operations in both public and private sectors

To develop incentives for loss reduction

Strategies

Demonstrate cost-effectiveness

By the year 2000, demonstrate to decision makers the cost-effectiveness of having in place performance standards for seismic loss reduction that affect major elements of the built environment.

Develop incentives and remove barriers

By the year 2000, identify and remove statutory and regulatory barriers that discourage loss reduction and develop economic and regulatory incentives to enhance seismic performance of existing and new construction.

Include property protection in building codes

By the year 2005, incorporate protection of property and functionality as an integral part of building code regulation.

Protect functionality of infrastructure

By the year 2000, incorporate protection of system functionality as an integral part of infrastructure design policy.

Benefits

Higher levels of seismic mitigation would reduce risks to life, to the state's economic base, and to the employment level after an earthquake. An effective property protection policy would reduce the tax impact by maintaining a more reliable employment and property tax base, in addition to reducing postearthquake recovery costs.

Responsibilities

Responsibility for program initiation rests at the state level; other public- and private-sector involvement occurs in much of the implementation. The state should provide strong leadership in directing a shift in public policy from a minimum prescriptive basis to a higher performance basis for seismic risk reduction. This shift will require participation from all elements of the public policy spectrum including state and local government agencies, the League of California Cities, financial and insurance institutions, and code organizations.

Costs

Cost to the state for agency implementation will be minimal, because the state's role is to motivate and to set policy and direction rather than to recommend new programs. Costs to local governments will also be minimal since they will primarily be administrators of the policy. Cost to the public will depend on the amount of mitigation required.

Incentives

Achieving the objectives of this element depends on its relative importance in the state's overall risk reduction plan. Reducing seismic risk in each structure will be valuable to the building owner, but the greatest motivator will be the public's demand for significant reduction in the personal and financial losses that normally result from earthquakes.

Land Use

Efficient use of land is one of the most critical issues in effective loss reduction and recovery from the disastrous effects of earthquakes. Because earthquake risk increases as the population increases, several areas of concern emerge with respect to land use: 1) generally, seismic hazard knowledge is neither adequately incorporated nor consistently applied in land-use decision making; 2) acceptable levels of seismic performance in new housing developments are not defined; 3) environmental review procedures do not adequately address seismic hazards; and 4) developments subject to inundation from potential dam or levee failure or tsunami effects are not adequately identified and protected.

Objective

To improve land-use planning so that balance is achieved between the needs of the state's increasing population and economic growth and the constraints imposed by seismic hazards

Strategies

Incorporate seismic hazards data in general plans

By the year 2000, update all urban area general plans with newly discovered information about seismic hazards, including potential inundation. Ensure that all local general plans are updated within one year of the date that new seismic hazard maps are published by the state or other recognized agencies and ensure consistent enforcement of all requirements.

Strengthen the California Environmental Quality Act (CEQA) process

By the year 2000, require that all projects subject to environmental review in accordance with CEQA are evaluated for seismic hazards, using the latest data published by the state.

Develop mitigation techniques

By the year 2000, develop and incorporate standards that reflect acceptable levels of seismic performance and loss reduction techniques for new and existing development.

Protect areas from inundation

By the year 2000, ensure that all areas subject to potential inundation from dam or levee failure or tsunami run-up have been adequately identified and that appropriate loss reduction strategies are incorporated in general plans.

Benefits

Land-use planning that incorporates strategies to deal with seismic hazards will help to eliminate potential "ghost-town" effects and their negative impact on long-range planning goals and will ensure economic and environmental viability.

Responsibilities

The state is primarily responsible for development of the data and publication of the seismic hazard maps. Local agencies are responsible for incorporation of the maps into their general plans and for enforcement. Public and private land owners and property developers are responsible for using the knowledge effectively and incorporating cost-effective mitigation techniques into each of their projects.

Costs

Cost to the state for review and coordination of local general plans will be minimal. Costs to local governments for formalizing the seismic hazard maps into their general plans will vary, depending on how and when required updating occurs. Costs to private developers will vary, depending on site-specific conditions.

Incentives

Land-use and zoning incentives such as density rights transfer, historic district bonuses, and zoning options should be considered. Incentives should be provided, or negative incentives removed, for owners who voluntarily comply with the latest known seismic hazard data and upgrade buildings' seismic performance without increasing the size or use of the facilities.

Existing Buildings

Many of California's buildings, including homes, are vulnerable to damage or destruction from earthquakes. Even some recently constructed buildings are deficient in terms of potential property loss. Most seismic retrofit projects to date have focused appropriately on life safety and have not significantly reduced the potential loss to property, personal disruption, and productivity. Continuing occurrence of earthquake damage to recently constructed buildings clearly demonstrates the need for significant improvement.

Objectives

To initiate aggressive efforts toward reducing loss of life and property vulnerability in existing buildings

To ensure that existing high-occupancy and essential buildings, public and private, are upgraded to provide acceptable performance when earthquakes occur

Strategies

Provide incentives to retrofit

By the year 2000, the economic system affecting property ownership and the building industry should provide incentives for retrofitting existing buildings' structural and nonstructural elements in accordance with performance standards that improve seismic resistance.

Initiate broad educational efforts

By the year 2005, educate building owners, design professionals, and others involved in the retrofit design and construction process about the benefit of retrofitting buildings for improved performance with attention to basic structures, nonstructural components, and operational elements.

Develop effective methodologies

By the year 2005, develop reliable, performance-based methodologies to ensure that seismic retrofit design and construction can be accomplished with consistent results. The methodologies should be based on investigation and understanding of how buildings and systems behave and on proper and cost-effective means, using new and existing technical knowledge and construction expertise.

Upgrade vulnerable buildings and other structures

By the year 2005, establish effective risk reduction programs to upgrade vulnerable single and multifamily housing, schools, and essential facilities in highly seismic areas, including publicly owned facilities.

Benefits

Significant reductions in life loss, property damage, and business interruptions will result from applying aggressive retrofitting strategies to vulnerable buildings.

Responsibilities

Responsibility rests at all levels of the public and private sectors. The state should take the lead in motivating and initiating the strategies and in implementing them for state-owned buildings. High priority should be placed on legislation, education, financial approaches, and code development that are necessary to achieve this goal.

Costs

The state's cost as motivator, setting policy and direction, will be minimal. Cost to local jurisdictions for implementation will be minimal. Cost to property owners for upgrading will vary, and the cost may be substantially mitigated, depending on the effectiveness of design and the incentives.

Incentives

Economic incentives for seismic retrofit may include alternative funding, reduced insurance rates, tax benefits, and extended longevity of the property. Experience indicates that retrofitting is stifled by a lack of clear financial incentive. Significant improvement, within an accelerated time frame, can be accomplished only when the economic advantage of improved seismic performance is recognized.

New Construction

Earthquake protection of new construction based on providing life safety and collapse-resistant structures has been reasonably successful in moderate earthquakes. Protection of property and economic loss control has not received as much emphasis and is not yet as successful. As a result, earthquake damage levels to recently completed buildings and the consequent personal and economic impact have been unacceptable. Both life safety and property preservation have been compromised by 1) incomplete information and knowledge of the performance of materials and systems; 2) lack of an integrated approach to seismic design; and 3) inadequate quality control in design and construction. The damage from recent, moderate earthquakes clearly demonstrates the need for continued improvement in achieving cost-effective seismic performance of new construction.

Objectives

To achieve reliable levels of life safety from earthquakes

To develop techniques that achieve higher levels of earthquake performance that will reduce potential property losses, minimize environmental damage, and enhance the economic viability of the state

Strategies

Include all new construction

By the year 2000, independently review and enforce the applicable seismic safety codes for all new construction, including publicly owned facilities, industrial facilities, and others now effectively exempt from building regulation.

Develop integrated approach to seismic design

By the year 2005, design new facilities using an integrated approach that considers all elements of the construction (structural and nonstructural elements, support systems, site improvements, etc.) that contribute to seismic performance. The responsibility must be vested in an identified design professional.

Adopt California-specific standards

By the year 2005, establish at all jurisdictional levels in California the ability to develop, adopt, and enforce those state amendments to the model building code that affect seismic safety and are necessary to meet the specific needs of the state.

Do performance-focused research

By the year 2000, sponsor and encourage problem-focused research and development to improve the reliability and economic effectiveness of performance-based seismic design and construction methods.

Benefits

Significant reductions in life loss, property damage, and business interruptions will result from applying aggressive seismic safety strategies to new construction.

Responsibilities

The state should, by example, take the lead in implementing the strategies and motivate all public entities to enforce current seismic regulations on all new construction.

Costs

Cost to the state and to local jurisdictions will be minimal. Cost to building owners generally will be less than 2 percent of the total construction cost, depending on the level of performance desired. Overall, the cost will be an insignificant fraction of the total life-cycle cost of a building.

Incentives

Incentives are the key to achieving increased levels of performance. Direct-to-owner economic incentives may include improved funding options, reduced insurance rates, tax policies, and the availability of unconventional funds similar to the "energy fund." Other incentives should also be considered, including zoning and building code options that reflect the value of improved seismic performance.

Utilities and Transportation

Both the utilities and transportation systems can experience severe disruptions under the following conditions: 1) when major supply lines and high-volume routes are insufficiently resistant to earthquakes or lack adequate redundancy (alternate systems); and 2) when numerous local distribution lines and secondary routes are seismically vulnerable and alternate systems are overwhelmed by widely distributed earthquake damage. Primary concerns about utilities include the critical lack of redundancy or upgrading in most public and private water supply systems (including vulnerable dams) and in older natural gas distribution systems; in transportation, essential highway bridge systems and major railroad systems are at great risk. Significant disruption of these systems could cause extensive long-term economic losses, societal disruption, and personal danger.

Objective

To ensure that all public and private utilities and transportation systems can withstand earthquakes to the degree that they will be able to 1) provide protection of life; 2) limit damage to property; and 3) provide for the resumption of system functions as soon as practicable. The accomplishment of this objective should result in only short-term interruptions, minimal personal losses, and minor economic disruption to the affected regions.

Strategies

Ensure performance standards

By the year 2000, establish seismic performance standards for all utilities and transportation systems, including interdependent systems (such as water and gas) to ensure adequate risk reduction strategies.

Understand and minimize secondary effects

By the year 2000, establish a comprehensive program to minimize the secondary effects (such as gas fires, hazardous material spills, sanitation overflows) that result from damage and disruption to a utility or transportation system so that life and property losses, environmental damage, and economic degradation can be reduced.

Evaluate and prioritize mitigation

By the year 2000, evaluate each system to identify its vulnerabilities for life safety and service disruption and prioritize risk reduction strategies, including redundancy, to minimize those vulnerabilities.

Retrofit critical systems

By the year 2010, ensure that retrofit of all major lifelines is evaluated, funded, and authorized so that the work can be accomplished in the funded time frame.

Benefits

More timely restoration of utilities and transportation links will ensure a significant reduction in societal costs and minimize economic devastation.

Responsibilities

Public and private owners of utility or transportation systems are responsible for attainment of these objectives and for preparing and carrying out their own seismic safety implementation plans. The state should establish policies on acceptable levels of performance, and monitor statewide utilities and transportation systems in their efforts to accomplish the strategies outlined.

Costs

Cost to the state for agency administration will be minimal. Cost to public and private owners of a utility or transportation system will depend on the amount of risk reduction work required. The retrofit of critical systems may require considerable expenditures.

Incentives

Incentives may include improved funding options, reduced insurance rates, positive tax policies, public recognition of good performance, governmental certification of reliable service, and regulatory options or trade-offs that reflect the value of the system's improved seismic performance.

Preparedness

Individuals, business owners, and corporate decision makers do not fully understand the potential loss of life, injury, personal dislocation, social disruption, and economic losses that can result from earthquakes. Several areas are of concern: 1) limited awareness of the potential for loss of life and injury; 2) a false sense of security based on the assumption that the government will protect against all economic losses; 3) no clear acceptance that a problem really exists (It won't happen to me); 4) an attitude that fails to recognize the need for self-reliance (Preparedness starts at home), expressing itself instead as There is nothing I can do about it; and 5) limited knowledge of what to do and how to pay for it.

Objectives

To increase understanding of the consequences (personal devastation, social disruption, and economic loss) that can result from earthquakes, the options for their mitigation, and the need to take action

To develop a comprehensive approach to preparedness by individuals, business owners, and corporate decision makers

Strategies

Increase understanding of potential impact

By the year 2000, develop an effective program that will increase individuals' understanding of the potential for loss of life, injury, personal dislocation, social disruption, and economic losses through consistent presentation of focused, in-depth information to individuals, business owners, and corporate decision makers.

Develop comprehensive, cost-effective approach

By the year 2000, develop a cost-effective, comprehensive approach to earthquake loss reduction that encompasses all aspects of an individual's life, from home to work place, including personal planning, securing contents and fixtures, building retrofit and long-term maintenance, and stockpiling critical supplies.

Increase the desire and ability to act

By the year 2000, develop economic and regulatory incentives to facilitate and reward actions that will reduce potential losses. Develop methods and procedures that will encourage individuals to act and will provide assistance for those actions.

Improve K–12 school preparedness

By the year 2000, ensure the effectiveness of a comprehensive program for preparedness in K–12 public and private schools. Minimize nonstructural hazards, stockpile critical supplies, and provide emergency response training for personnel.

Benefits

A fully informed and prepared citizenry will have a reduced demand for emergency response and less individual and business disruption.

Responsibilities

The state should take the lead in motivating and coordinating the statewide preparedness system and the strategies outlined. Local agencies will be responsible for implementation. Other public levels and the private sector will be involved in much of the implementation.

Costs

Cost to the state and to local jurisdictions will be minimal. Cost to individuals and building owners generally will be relatively low and will depend on the extent of preparation undertaken. Overall, the cost will be an insignificant fraction of the total life-cycle cost.

Incentives

Achieving the objectives of this element depends on establishing a strong state policy as part of its overall risk reduction plan. Although the need for effective preparedness should be obvious, the greatest motivation to improve the current system will be to satisfy the public's demand for a significant reduction in the personal and financial losses that normally result from earthquakes.

Emergency Response

Emergency management and response systems have improved with each event. However, deficiencies still exist in the following areas: 1) people and resources for better communication during and after an event; 2) new medical resources because of the rapidly changing health care system; 3) resources for effective search and rescue operations; and 4) collection and dissemination of reliable information. Deficits in the indicated areas have hampered the effectiveness of emergency response to even moderate earthquakes; their impact will cause significant failure during major earthquakes.

Objectives

To seek continual improvement in emergency management and response systems

To ensure that information management and communications networks will be effective, current and future medical resources will be sufficient, search-and-rescue systems will be able to achieve more effective use of all resources, and the public is well-informed and better prepared

Strategies

Improve communications

By the year 2005, improve statewide communication networks to provide for effective transmission of emergency information for emergency response organizations, including intergovernmental, multiagency, and multijurisdictional operations. The communication systems should be available in-depth and interoperable.

Improve medical response

By the year 2000, ensure that the rapidly changing health care system supports emergency response needs with emphases on planning, training, and coordination. Ensure continued support of the medical and health mutual aid system.

Improve search and rescue

By the year 2005, improve the search-and-rescue system. Establish and maintain properly equipped and staffed regional search-and-rescue training facilities to provide real-life preparedness training for response personnel. Ensure that an ample supply of specialized equipment can be obtained and that staff can be recruited through joint responsibility arrangements with local search-and-rescue operations.

Improve data collection and dissemination

By the year 2000, improve the collection and dissemination of damage intelligence and other critical information through a network of regionally coordinated information management systems that will gather, validate, and deliver data immediately after earthquakes occur.

Benefits

Improved and effective emergency responses will lead to preservation of lives and property.

Responsibilities

The state should take the lead in motivating and coordinating the statewide emergency response system. The state is responsible for creating and operating training facilities. Local agencies will be responsible for staff utilization. Other public levels and the medical community, media, and private sector will provide much of the implementation.

Costs

Cost to the state for implementation of the strategies will be considerable. Cost to local agencies should be minimal because the strategies envision the use of existing personnel and resources. Cost to end users should be negligible.

Incentives

Achieving the objectives of this element will depend on a strong state policy on emergency response in the overall risk reduction plan. Although the need for effective emergency response should be obvious, the greatest motivation to improve the current system will be the public's demand for significant reduction in the personal and financial losses that normally result from earthquakes.

Recovery

Recovery methods have improved with each earthquake; however, there are still a number of deficiencies that impair effective and speedy recovery and have resulted in unacceptable levels of personal and financial loss. Deficiencies exist in 1) effective management of the recovery process; 2) adequate interim shelter and housing, particularly for those with special needs; 3) plans and resources to accommodate interim and long-term postearthquake housing; and 4) adequate knowledge and preparation by the public for effective recovery.

Objective

To establish a statewide earthquake recovery plan aimed at normalizing the social and economic environment through better and more responsive plans and procedures

Strategies

Establish statewide recovery plan

By the year 2000, establish a statewide earthquake recovery plan aimed at normalizing the social and business environment and minimizing the time and cost of recovering from an earthquake. The plan should define the operational period of a disaster to include the beginning phases of recovery.

Improve interim and long-term housing

By the year 2000, develop plans for interim housing that respond to varying levels of loss and alternative strategies for the financing of long-term housing reconstruction. Include improved data collection on housing losses and recovery costs.

Streamline permitting and rebuilding process

By the year 2000, develop the guidelines to streamline the permitting and rebuilding process so that disruption of individuals and businesses is minimized and rapid personal and economic recovery is assured.

Ensure accurate and timely information

By the year 2000, ensure that accurate and timely recovery information is disseminated to the public and private sectors through all available means.

Benefits

Economic and social impact over the long term will be minimized, and personal dislocation and business failure will be reduced.

Responsibilities

The state should take the lead in motivating and coordinating the statewide recovery system and the strategies outlined. Local agencies will be responsible for implementation. Other public levels and the private sector will be involved in much of the implementation.

Costs

Cost to the state for development of the guidelines will be minimal. Cost to local agencies should be minimal since the plan envisions using existing personnel. Cost to end users should be negligible.

Incentives

Achieving the objectives of this element will depend on a strong state policy on recovery in the overall risk reduction plan. Although the need for effective personal and economic recovery should be obvious, the greatest motivation to improve the current system will be the public's demand for significant reduction in the personal and financial losses that normally result from earthquakes.

The Initiatives

The *California Earthquake Loss Reduction Plan* sets forth the basic policy and direction with which to seek the vision and reach the goals (see pages 2 and 3) by the year 2010. The initiatives provide definitive statewide strategies that will lead to the intended goal. Just as each element of the plan is considered an integral part of the vision for a safer California, the initiatives provide a necessary and integrated vehicle to focus the state's efforts in that quest. The initiatives have been developed in recognition of, and with experience from, ongoing programs, setting forth practicable plans of action to guide the implementing agencies.

Each initiative is expressed as an action to be accomplished, indicating its priority, its potential cost, and the time frame for its accomplishment. The primary goal of the plan is loss reduction. The actions called for in these initiatives are intended to help achieve that goal. As the detailed action plans are developed, they must be evaluated for the contribution they make toward achieving the goal, the practicality of their accomplishment, and the economic benefit they provide.

Each initiative has been given a priority and a date for its accomplishment. Detailed action plans will be developed and costs will be determined for each initiative during the implementation stage.

Priority	All of the initiatives are considered necessary to achieve the state's goals. However, for effective administration of the overall plan, they have been organized by priority into three levels: *Critically Important*, *Very Important*, and *Important*.
Date	Each initiative should be started and completed as soon as practical. The date indicated is considered a reasonable date by which the initiative should be accomplished.

Implementing the initiatives will require a cooperative effort of various entities, both public and private at local, state, and national levels. Precise action plans or tactics that define who is responsible and how an initiative is to be accomplished will be developed by the Administration, the Legislature, and others responsible and affected.

The following pages summarize the initiatives within each element of the plan.

Geosciences

Objective: *Full Application of Geosciences*

Strategies and Initiatives

1.1 Improve Use of Current Geologic Knowledge

1.1.1 Ensure efficient, accurate, and reliable completion of the statewide Seismic Hazard Mapping Program, as soon as practicable, based on independent review and acceptance of appropriate procedures to compile the data and construct the maps. Include end users and others affected as part of the independent review.

Priority: Critically Important
Date: 2010

1.1.2 Include, as part of the Seismic Hazard Mapping Act, identification and mapping of all seismic sources, where appropriate, including buried or blind faults.

Priority: Very Important
Date: 2000

1.1.3 Establish uniform standards for installing and maintaining strong motion instruments, including timely and effective processing and disseminating of the resulting data, in significant public and private structures as a part of the Strong Motion Instrument Program.

Priority: Important
Date: 1999

1.1.4 Require federal and state dam owners to comply with and pay for strong motion instrumentation of their dams as a part of the Strong Motion Instrumentation Program.

Priority: Important
Date: 2000

1.2 Apply Consistent Geologic Standards

1.2.1 Require local governments to consistently apply and enforce in all zoning and building code applications the criteria in the Seismic Hazard Mapping Act and the Alquist-Priolo Earthquake Fault Zone Act.

Priority: Very Important
Date: 1999

1.2.2 Incorporate geologic knowledge in planning, design, and construction processes at the initial phase of public consideration and ensure that site-specific data is required for all projects.

Priority: Very Important
Date: 1998

1.2.3 Ensure that the design of new facilities and the retrofit of existing ones (major transportation and utility systems and hazardous material facilities) address the earthquake hazards identified in the Seismic Hazard Mapping Act and the Alquist-Priolo Earthquake Fault Zone Act.

Priority: Important
Date: 2000

1.3 Show Cost-Effectiveness

1.3.1 Develop and implement effective educational and informational programs that demonstrate the cost-effectiveness of using site-specific geologic data when designing new and retrofitting existing facilities. Make use of existing case histories where possible.

Priority: Very Important
Date: 2000

1.3.2 Develop and implement effective educational and informational programs aimed at technical professionals to increase their understanding of strong motion phenomena, including near-source and ground deformation. Demonstrate success in the use of good geologic standards of practice in the technical professions.

Priority: Very Important
Date: 2000

1.3.3 Develop and implement effective educational and informational programs that demonstrate the cost-effectiveness of using geological data for accurate scenarios for earthquake preparedness and response planning.

Priority: Important
Date: 2000

1.4 Support Ongoing Research

1.4.1 Develop data necessary to provide accurate and useful planning scenarios to reduce the risk from the hazards of seiches and tsunamis.

Priority: Important
Date: 2000

Research and Technology

Objective: *Comprehensive Applied Research Plan*

Strategies and Initiatives

2.1 *Establish Program for Risk Reduction*

2.1.1 Cosponsor and support California-based seismic research programs funded by federal agencies or the private sector.

Priority: Critically Important
Date: 1998

2.1.2 Provide procedures to carry out the Seismic Safety Commission's *Research and Implementation Plan for Earthquake Risk Reduction in California, 1995 to 2000.* Include provisions for 1) public oversight and priority-setting functions; 2) researchers who work with end users to implement the plan; and 3) research that is conducted by other public and private parties.

Priority: Critically Important
Date: 2000

2.1.3 Establish the program for earthquake risk reduction to coordinate state-sponsored, problem-focused research directed at providing information about seismic safety in California. Maintain a specific implementation element in the program to facilitate and encourage the incorporation of existing and new knowledge into professional practice.

Priority: Important
Date: 1999

2.1.4 Initiate a problem-focused research effort as part of the California Program for Earthquake Risk Reduction to provide the technical basis for development of performance-based building codes, standards, and practices.

Priority: Important
Date: 2000

2.2 *Ensure Applicability to Risk Reduction*

2.2.1 Apply cost-effective defense and space technologies to earthquake risk reduction efforts.

Priority: Very Important
Date: 2000

2.2.2 Require all state-funded seismic research to include active participation by design professionals from the outset through implementation and dissemination.

Priority: Important
Date: 1998

2.2.3 Promote links between earthquake research organizations and industry to evaluate the performance of new technologies, components, and systems.

Priority: Important
Date: 1998

2.2.4 Work with federal agencies and research organizations to support development of education programs for design professionals and building officials that implement research on new and existing buildings, including performance-based engineering guidelines.

Priority: Important
Date: 1999

2.2.5 Promote programs of continuing education through existing professional associations so that research results are communicated to design professionals and land planners.

Priority: Important
Date: 1998

2.3 *Demonstrate Benefit of Research to Performance*

2.3.1 Document the connections between past research and the practical benefits that have flowed from it. Communicate that information to design professionals, researchers, policy makers, and the public.

Priority: Important
Date: 2000

2.4 *Coordinate Existing Research Activities*

2.4.1 Convene workshops, seminars, and public hearings through the California Program for Earthquake Risk Reduction, involving users of earthquake research to help establish priorities for reducing earthquake risk. Ensure the results of these activities will be reflected in research objectives, plans, and priorities.

Priority: Important
Date: 2000

2.4.2 Maintain a database of California earthquake research activities, investigations, and research results that are relevant to California's needs.

Priority: Important
Date: 1998

Education and Information

Objective: *Increased Knowledge to Make Effective Decisions*

Strategies and Initiatives

3.1 *Promote Competency of Professionals*

3.1.1 Require continuing education in all applicable seismic safety issues as a prerequisite to licensing renewal for all professionals associated with siting, design, and construction of structures.

Priority: Critically Important
Date: 2000

3.1.2 Integrate earthquake loss reduction principles in the basic curricula for all appropriate land use, design, and construction-related professional education programs.

Priority: Very Important
Date: 2000

3.2 *Increase Public Awareness*

3.2.1 Develop short courses in earthquake fundamentals, seismic hazards identification, safety information about potentially hazardous building contents, workplace safety, emergency plans, and risk-assessment techniques and tools. Target representatives of business and industry with responsibilities related to property.

Priority: Very Important
Date: 2000

3.2.2 Provide tools to media practitioners to ensure reporting accuracy and to increase the level of understanding among reporters and writers.

Priority: Important
Date: 2000

3.3 *Inform Public Officials*

3.3.1 Conduct workshops for state, city, and county officials on vulnerability assessment and loss reduction measures.

Priority: Important
Date: 1999

3.3.2 Develop and disseminate information on how to establish and manage community coalitions to support loss reduction.

Priority: Important
Date: 2000

3.4 *Establish K–12 Earthquake Program*

3.4.1 Develop and implement cohesive K–12 curriculum elements on earthquake fundamentals that span the sciences, environment, mathematics, history–social science, computer science, and language arts. The aim of this effort is that California schools will produce both informed citizens and new generations of scientists, planners, legislators, communicators, and business leaders.

Priority: Important
Date: 2005

3.4.2 Provide opportunities for preservice and in-service training of teachers that relate to earthquake fundamentals, preparedness and response issues within the sciences, environment, mathematics, history–social science, and language arts curricula.

Priority: Important
Date: 2001

Economics

Objective: *Shift Design and Construction Policies to Economic Value Basis*

Strategies and Initiatives

4.1 Demonstrate Cost-Effectiveness

4.1.1 Develop financial study models and real case studies that demonstrate the cost-effectiveness of specific design and construction methods based on increased levels of property, contents, and functionality protection. Make those findings available to the public policy makers, and the lending, insuring, and taxing agencies.

Priority: Very Important
Date: 2000

4.1.2 Develop reliable simulation models that demonstrate the cost-effectiveness of enhanced performance standards.

Priority: Very Important
Date: 2000

4.2 Develop Incentives and Remove Barriers

4.2.1 Amend state income and sales tax policies to provide incentives for loss reduction measures.

Priority: Very Important
Date: 1999

4.2.2 Establish objective criteria in which seismic performance of structures is incorporated into mortgage loan rates and underwriting practices. Work with the mortgage lending industry to accomplish.

Priority: Very Important
Date: 1998

4.2.3 Establish objective criteria in which seismic performance of structures is incorporated into insurance premiums and underwriting practices. Work with the insurance industry to accomplish.

Priority: Very Important
Date: 1998

4.2.4 Identify and eliminate state and local regulatory and financial disincentives for seismic retrofit.

Priority: Very Important
Date: 2000

4.3 Include Property Protection in Building Codes

4.3.1 Incorporate higher standards for seismic design in model codes, based on protection of property and functionality.

Priority: Critically Important
Date: 2003

4.3.2 Develop statewide constituency to establish the effective levels of property-based performance codes.

Priority: Important
Date: 2005

4.4 Protect Functionality of Infrastructure

4.4.1 Establish public policy that incorporates increased seismic design standards in the design and construction of infrastructure, based on the need to maximize functionality after earthquakes.

Priority: Important
Date: 2000

Land Use

Objective: *Achieve Balance Between Growth and Seismic Hazards*

Strategies and Initiatives

5.1 *Incorporate Seismic Hazards Data in General Plans*

5.1.1 Require geotechnical and geologic reports that specify seismic hazards for all subdivisions (unless waived because adequate information already exists), pending the completion and adoption of mapping under the Seismic Hazards Mapping Act for any jurisdictional area.

Priority: Critically Important
Date: 2000

5.1.2 Amend state planning law to require local governments to review and update the safety element every five years or sooner, if appropriate, to incorporate the most recent geologic and technical information available.

Priority: Very Important
Date: 1998

5.2 *Strengthen the California Environmental Quality Act (CEQA) Process*

5.2.1 Amend the CEQA guidelines, including appendixes G and I, to explicitly require initial studies and environmental impact reports (EIRs) to address seismic hazards. Require appropriate technical experts to prepare initial studies and EIRs. Give local government emergency managers an opportunity to review initial studies and EIRs so that seismic hazards may be adequately addressed.

Priority: Very Important
Date: 2000

5.3 *Develop Mitigation Techniques*

5.3.1 Require local governments to list and catalog, in accordance with geographical data, seismic and geologic hazards reports submitted to them with normal environmental, subdivisional, and other project-review procedures. Make reports available to the public as required by the Public Information Act.

Priority: Very Important
Date: 1999

5.3.2 Amend state planning law to establish policies and mitigation requirements in the safety elements of local general plans that relate to the use, occupancy, and rehabilitation of buildings that are considered seismically vulnerable.

Priority: Important
Date: 1998

5.3.3 Review potential tsunami hazards, prepare inundation maps, and recommend appropriate mitigation strategies and responsibilities.

Priority: Important
Date: 2000

5.4 *Protect Areas from Inundation*

5.4.1 Require owners, developers, and flood control districts to prepare and revise inundation maps every ten years in light of major new downstream development. Amend land-use laws to require that current and updated dam inundation maps be available and reviewed before development of critical facilities and large-scale projects is approved.

Priority: Important
Date: 1999

5.4.2 Require proponents of critical facilities and major large-scale developments located downstream of dams to review and update inundation maps as necessary, incorporating recent changes and expansion.

Priority: Important
Date: 2000

5.4.3 Amend statutes to impose sanctions on dam owners who fail to prepare and submit inundation maps as required.

Priority: Important
Date: 1998

5.4.4 Amend state planning law to require that state and local agencies make specific findings regarding the acceptability of inundation hazards before approving development of critical facilities and large-scale developments.

Priority: Important
Date: 1998

Existing Buildings

Objective: *Upgrade Vulnerable Buildings and Other Structures*

Strategies and Initiatives

6.1 *Provide Incentives to Retrofit*

6.1.1 Encourage economic incentives such as improved mortgage terms, reduced insurance rates, and positive tax benefits for upgrading structural and nonstructural elements in buildings.

Priority: Critically Important
Date: 1999

6.1.2 Amend the *California Building Code* to allow upgrading of a building's structural and nonstructural elements without triggering other code upgrade requirements, provided that the work is intended to improve the building's seismic performance.

Priority: Important
Date: 2000

6.2 *Initiate Broad Educational Efforts*

6.2.1 Develop and implement continuing education programs in seismic design principles, including safety assessment training for all building inspectors, plan checkers, and construction trades.

Priority: Critically Important
Date: 2005

6.2.2 Develop and implement plans to increase general knowledge of and appreciation for the value of upgrading of a building's structural and nonstructural elements so that the building's seismic resistance is improved.

Priority: Very Important
Date: 2001

6.3 *Develop Effective Methodologies*

6.3.1 Continue efforts to develop reliable methodologies and codes for 1) minimum prescriptive retrofit standards; and 2) enhanced performance-based retrofit standards for structural and nonstructural elements of all public and private buildings, including those of essential services and higher education institutions, that can provide cost-effective improvement of the buildings' seismic resistance.

Priority: Very Important
Date: 2005

6.4 *Upgrade Vulnerable Buildings and Other Structures*

6.4.1 Report to the public the changes in understanding of the seismic vulnerability of selected buildings or conditions that warrant wide attention. Initially, address the special problem posed by welded steel moment frame buildings and ways to handle the technical, administrative, and public policy issues they present.

Priority: Critically Important
Date: 1998

6.4.2 Ensure that essential service and hospital buildings can continue to operate in the event of an earthquake as required by current law, including the continuance of all utility services and systems necessary for proper operation of the facilities.

Priority: Very Important
Date: 2005

6.4.3 Develop a program to identify potentially vulnerable public and private buildings and establish a mitigation plan to reduce the risk posed by those buildings, including structural and nonstructural elements, equipment, and contents, with the most vulnerable and most essential buildings addressed as the highest priority. Include essential service facilities, hospitals, schools (including higher education buildings), general occupancy buildings, parking structures, and residential buildings (including mobile homes).

Priority: Very Important
Date: 2002

6.4.4 Adopt, by legislation, model codes appendix chapters 5 and 6 of the *Uniform Code for Building Conservation* for the seismic retrofit of tilt-up buildings and older homes.

Priority: Very Important
Date: 1998

6.4.5 Adopt modifications to the building codes, including the *Historic Building Code*, to include seismic retrofit of seismically vulnerable buildings when major modifications, alterations, or additions to the buildings require issuance of a building permit.

Priority: Important
Date: 1998

6.4 *Upgrade Vulnerable Buildings and Other Structures (Continued)*

6.4.6 Enforce the *California Building Code* for all modifications, alterations, or additions to state-owned buildings.

Priority: Important
Date: 1998

6.4.7 Encourage building occupants, lease holders, mortgage providers, and insurers to require building owners to disclose seismic risks and options to mitigate them prior to executing new or continuing financial commitments in connection with building use.

Priority: Important
Date: 1999

6.4.8 Adopt legislation to require compliance with the current unreinforced masonry (URM) law in accordance with the *Uniform Code for Building Conservation* (UCBC).

Priority: Important
Date: 1998

New Construction

Objective: *Increased Life Safety and Property Protection*

Strategies and Initiatives

7.1 *Include All New Construction*

7.1.1 Require that all state, local, and special agencies have construction projects regulated by independent building code enforcement entities with enforcement, citation, and stop-work authority. Assign a government official to be responsible for enforcement of codes and regulations.

Priority: Critically Important
Date: 1999

7.1.2 Require public utilities, essential facilities, public owned facilities, and hazardous waste facilities not currently regulated under the Alquist-Priolo Earthquake Fault Zone Act and the Seismic Hazards Mapping Act to incorporate mitigation for earthquake-induced site instability.

Priority: Very Important
Date: 2000

7.2 *Develop Integrated Approach to Seismic Design*

7.2.1 Clarify the *California Building Code* to assign responsibility for seismic resistance design and quality assurance during construction of all building elements and components.

Priority: Critically Important
Date: 1999

7.2.2 Implement training, quality control, and enforcement procedures to ensure that all new construction is built to the intent of the design and the building code.

Priority: Important
Date: 2005

7.3 *Adopt California-Specific Standards*

7.3.1 Amend statute to allow California to adopt amendments to national model building codes that apply to all state and local jurisdictions so that seismic performance of construction may be enhanced and the codes can be enforced for all new construction.

Priority: Critically Important
Date: 1998

7.3.2 Amend the *California Building Code* to require that seismic design strategies of public and private acute-care hospital facilities be applied to equipment and contents as well as structural and nonstructural elements so that they will remain functional after an earthquake.

Priority: Very Important
Date: 1998

7.3.3 Ensure that essential service and hospital buildings can continue to operate in the event of an earthquake, as required by current law, including the continuance of all utility services and systems necessary for proper operation of the facility.

Priority: Very Important
Date: 2005

7.3.4 Amend the *California Building Code* to require independent review for important, irregular, complex, special-occupancy, and critical facilities and for all buildings where mandated enhanced-performance objectives are required.

Priority: Important
Date: 1998

7.3.5 Amend statute to allow any interested party to submit proposed amendments to the *California Building Code* for consideration and adoption by the California Building Standards Commission.

Priority: Important
Date: 1998

7.4 *Do Performance-Focused Research*

7.4.1 Organize and provide continuing support for research that will substantiate performance-based design procedures for buildings.

Priority: Important
Date: 2000

7.4.2 Organize and provide substantial, continuing support to develop performance-based design and construction procedures for buildings, participating with other organizations to the extent practical.

Priority: Important
Date: 2000

Utilities and Transportation

Objectives: *Protect Life, Limit Property Damage, Resume Function*

Strategies and Initiatives

8.1 Ensure Performance Standards

8.1.1 Establish performance standards for designing, constructing, maintaining, and inspecting all public and private utility and transportation systems. Include related critical facilities and consideration of the interdependency between systems.

Priority: Critically Important
Date: 2000

8.1.2 Require utilities that are *not* regulated by the California Public Utilities Commission (PUC) to comply, as a minimum, with the equivalent seismic performance standards required of utilities that are regulated by the PUC.

Priority: Critically Important
Date: 1999

8.1.3 Require public and private utilities and transportation systems to address the earthquake hazards identified in the Alquist-Priolo Earthquake Zone Act and the Seismic Hazards Mapping Act.

Priority: Important
Date: 1998

8.2 Understand and Minimize Secondary Effects

8.2.1 Develop and implement a comprehensive educational program to instruct providers and users of utility and transportation systems about the management of potential secondary hazards inherent in even minimal failure of a system damaged by an earthquake. Include all forms of secondary hazards—from major transportation spills of hazardous materials to natural or liquefied petroleum gas leaks at mobile home parks, electrically ignited fires, and bracing of gas water heaters.

Priority: Important
Date: 2000

8.3 Evaluate and Prioritize Mitigation

8.3.1 Develop effective methods of minimizing utility system disruption from earthquake-damaged transmission and distribution lines (gas, electrical, water, and waste water), including earthquake activated shutoff and restart, monitoring, and management systems.

Priority: Important
Date: 2000

8.3.2 Develop methods to ensure effective interprovider coordination for maintaining and restoring critical systems to reasonable levels of service following damaging earthquakes. Encourage the voluntary actions from existing and future interprovider seismic working groups, consisting of representatives from each type of utility and transportation provider.

Priority: Important
Date: 2000

8.4 Retrofit Critical Systems

8.4.1 Identify potentially vulnerable public and private primary water supply and distribution facilities, including state- and federally regulated dams, and public and private levees. Upgrade vulnerable systems to ensure maintaining and restoring essential systems, subsequent to damaging earthquakes, to reasonable levels of service as defined by the PUC.

Priority: Very Important
Date: 2010

8.4.2 Identify potentially vulnerable major transportation arteries that have minimal redundancy where service disruption would cause significant hardship on the communities served. Establish functional priorities and upgrade or replace as appropriate to ensure maintaining and restoring major arteries to reasonable levels of service.

Priority: Very Important
Date: 2010

Preparedness

Objective: *Comprehensive Approach to Loss Reduction*

Strategies and Initiatives

9.1 *Increase Understanding of Potential Impact*

9.1.1 Develop information for individuals, families, and the business sector about the human and economic impact of earthquakes. Include preparedness and mitigation plans. Develop and implement strategies for delivering the information in appropriate forms and community languages.

Priority: Very Important
Date: 2000

9.1.2 Develop information for community-based organizations (CBOs) and nongovernmental organizations (NGOs) about the social disruption caused by earthquakes. Include information about actions they can take to prepare for and mitigate the effects.

Priority: Very Important
Date: 2000

9.2 *Develop Comprehensive, Cost-Effective Approach*

9.2.1 Encourage CBOs and NGOs to expand training programs in preparedness and loss reduction so that they can effectively help their constituents to reduce potential losses and continue to serve them after an earthquake.

Priority: Important
Date: 2000

9.2.2 Extend applicability of the existing *Home Owner's Guide* to all housing. Develop a similar document and procedure for multifamily housing.

Priority: Important
Date: 1999

9.2.3 Develop public policy establishing a comprehensive, five-year program for seismic upgrading of private homes that are vulnerable because of factors such as unbraced water heaters, unreinforced masonry chimneys, unbolted foundations, unbraced cripple walls, and weak (soft story) configurations. Use the current residential water heater program as a model.

Priority: Important
Date: 1998

9.2.4 Encourage voluntary seismic inspections (including estimates of the cost for correcting deficiencies) at the time of resale of any residential property as part of the Home Warranty inspection process.

Priority: Important
Date: 1998

9.3 *Increase the Desire and Ability to Act*

9.3.1 Promote the establishment of Community Emergency Response Team (CERT) programs in all communities throughout the state.

Priority: Very Important
Date: 2000

9.3.2 Expand the scope of Neighborhood Watch programs to include earthquake preparedness and neighborhood earthquake response in all communities in the state.

Priority: Very Important
Date: 2000

9.3.3 Develop economic and regulatory incentives for home and business owners to facilitate and reward actions that will reduce potential losses, such as securing nonstructural elements, contents, and fixtures against potential hazards.

Priority: Important
Date: 1999

9.3.4 Develop and maintain a state presence on the Internet that spotlights earthquake preparedness, inviting discussion and informing the public about regulations, methods, and procedures for loss reduction. Include related public-domain documents.

Priority: Important
Date: 1998

9.4 *Improve K–12 School Preparedness*

9.4.1 Establish specific accountability of school and district administrators to implement the requirements for provision of school emergency plans and staff training as required by the current *Education Code*. Require compliance with the Standardized Emergency Management System (SEMS).

Priority: Critically Important
Date: 2000

9.4.2 Establish specific accountability of school and district administrators to implement the requirements for minimizing nonstructural hazards and ensuring a sufficient stockpile of water and other critical supplies to be used for first aid, sanitation, and food.

Priority: Very Important
Date: 2000

Emergency Response

Objective: *Improved Emergency Management and Response Systems*

Strategies and Initiatives

10.1 Improve Communications

10.1.1 Provide upgraded regional and local emergency communications, including 1) mutual-aid channels for police, fire, and emergency medical services; 2) regional emergency communications councils with authority to establish regional standards for emergency communication; and 3) response and recovery public broadcast channels for the public.

Priority: Critically Important
Date: 2005

10.1.2 Provide more efficient use of the rapidly changing cellular and potential satellite telephone system during emergencies. Include priority access to cellular service for emergency use, the deployment of portable satellite cell sites, limited public access to cellular phone service during emergency, and the possible extension of communications ability by use of other emergency technologies.

Priority: Very Important
Date: 2001

10.1.3 Equip local government operations area to both send and receive Emergency Digital Information Systems (EDIS) messages.

Priority: Important
Date: 2001

10.2 Improve Medical Response

10.2.1 Provide a permanent and sustainable funding source for regional planning personnel and other improvements in the medical and health mutual aid system.

Priority: Very Important
Date: 2000

10.2.2 Provide an effective system to incorporate outpatient clinics, skilled-nursing facilities, and speciality clinics in the local medical and health disaster response system.

Priority: Very Important
Date: 1999

10.2.3 Provide adequate training for nongovernmental staff and personnel providing medical and health disaster response in accordance with the Standardized Emergency Management System's (SEMS) approved course of instruction and the Hospital Emergency Incident Command System.

Priority: Important
Date: 2000

10.3 Improve Search and Rescue

10.3.1 Establish and maintain regional search and rescue training facilities to provide real-time preparedness training for emergency response personnel. Ensure that the facilities are properly equipped and staffed.

Priority: Important
Date: 2001

10.3.2 Provide an adequate cache of specialized emergency equipment and staff through joint responsibility arrangements with local search and rescue operations.

Priority: Important
Date: 2005

10.3.3 Improve emergency response coordination among state and local levels of government, the emergency response organizations, and supporting private sector entities.

Priority: Important
Date: 1999

10.4 Improve Data Collection and Dissemination

10.4.1 Improve the capability and quality of computer simulation models for predicting where to expect damage in the immediate aftermath of an earthquake.

Priority: Important
Date: 2000

10.4.2 Finalize procedures and training for use of Emergency Managers Mutual Aid (EMMA). Ensure input from local emergency officials. Include criteria for selection and methods for reimbursement.

Priority: Important
Date: 1999

10.4.3 Develop and distribute a well-organized media handbook for media representatives' postearthquake use.

Priority: Important
Date: 2000

Recovery

Objective: *Statewide Recovery Plan and Implementation*

Strategies and Initiatives

11.1 Establish a Statewide Recovery Plan

11.1.1 Develop a reliable and effective statewide recovery plan.

Priority: Critically Important
Date: 1999

11.1.2 Seek alternative sources of funding for disaster recovery.

Priority: Critically Important
Date: 2000

11.1.3 Maintain and augment, as necessary, provisions for ensuring human services such as sheltering, feeding, medical care, and psychological assistance.

Priority: Very Important
Date: 2000

11.1.4 Develop a reliable program for incorporating reassurance teams (including appropriate specialties such as psychology, nursing, communications, clergy, building inspection, etc.) into local emergency plans, including coverage of all areas of assurance and all jurisdictional levels.

Priority: Important
Date: 1998

11.1.5 Plan for shelter, interim housing, and other recovery needs unique to people with special needs, including those who are frail, elderly, and disabled.

Priority: Important
Date: 1999

11.1.6 Establish the definition of the operational period of a disaster to include the beginning phases of recovery, the organizational responsibilities, the use and coordination of volunteer assistance, and other elements as necessary.

Priority: Important
Date: 1998

11.1.7 Plan for the effective removal and disposal of rubble after earthquakes tailored to the needs of each region.

Priority: Important
Date: 1999

11.1.8 Update and distribute regional earthquake recovery manuals.

Priority: Important
Date: 1999

11.2 Improve Interim and Long-term Housing

11.2.1 Plan for accommodating large displaced populations on an interim basis, using military facilities, publicly owned parks and recreational facilities, and manufactured housing.

Priority: Critically Important
Date: 1999

11.2.2 Develop incentives for landlords to make vacancies available for interim housing.

Priority: Very Important
Date: 1999

11.2.3 Identify potential vulnerability in existing housing stock and develop potential damage models that incorporate the data thus found. Maintain a database of actual housing losses and recovery costs from all earthquakes and incorporate the data in that already collected for potential damage models to ensure adequacy of long-term housing.

Priority: Important
Date: 2000

11.3 Streamline Permitting and Rebuilding Process

11.3.1 Develop guidelines to assist local governments in streamlining the permitting and rebuilding process through the use of "one-stop" centers. This process will minimize the disruption of individuals and businesses and accomplish personal and economic recovery in the fastest time possible.

Priority: Important
Date: 2000

11.3.2 Develop a model plan for postdisaster permitting of repairs and modifications.

Priority: Important
Date: 2000

11.4 Ensure Accurate and Timely Information

11.4.1 Develop a collaboration between government and the media to establish a Government/Media Task Force to integrate emergency and recovery public information with emergency and recovery management.

Priority: Important
Date: 2000

The Benefits

Mitigation works! Loss reduction is possible and practical.

Upgrading existing vulnerable structures, using better designs in new construction, and increasing preparedness in all areas are the most cost-effective ways to reduce loss and achieve recovery from earthquakes.

Quantifying benefits is not easy. Common sense tells us that action taken to reduce the loss from earthquakes produces better results than inaction. If a building is constructed to higher performance standards, it will suffer less damage than one not constructed to those higher standards. But the questions often asked—how much better, is it cost-effective, or has it been proved in an actual event—all go unanswered. Unfortunately, current quantitative cost-benefit analysis is not far enough along to support what common sense and good professional judgment tell us is true about earthquake mitigation. The reason lies in several areas: 1) placing a dollar value on life itself has not reached universal acceptance; 2) placing a dollar value on the speculation of damage and disruption is still an inexact process; 3) predicting when and how big an earthquake will impact any particular building cannot be done accurately; and 4) real-life testing before and after mitigation is not possible. The benefits are sure to accrue but the amounts are hard to quantify. Therefore, the deciding factors in mitigation are most often based on qualitative rather than quantitative analysis.

Compared with the criteria used in other seismically active areas of the world, California's higher standards of construction show that the benefits are real even if they cannot be quantified. Comparisons of earthquakes in Northridge, California, 1994; Kobe, Japan, 1995; and Mexico City, Mexico, 1985 (see chart) prove that higher standards produce lower degrees of loss.

Taking Action

It is a fact that mitigation works, but there is still the question of cost. From all levels of government to corporations and small businesses, estab-

	Northridge	Kobe	Mexico City
Loss of life	57	5,400	10,000
Destruction of buildings	14,000	150,000	(not available)
Disruption of business	days	weeks	months

lishing the mandate, committing the resources, and authorizing the work will not happen unless some evaluation of the required resources has been completed.

Traditionally, the focus has been on life safety. That minimum level of seismic mitigation has been driven by mandatory government actions. Today, however, there is a growing trend toward mitigating economic loss by voluntarily setting higher standards to protect property and ensure continuance of business operations. The combined economic losses from the Loma Prieta earthquake in 1987 and the Northridge earthquake in 1994 exceed $50 billion. Northridge alone sustained the largest economic loss caused by a natural disaster in United States history. We know mitigation saves lives, but significant increases in economic loss have established the need for higher standards and motivated the movement toward mitigation.

In California the mitigation movement is still in its infancy. In a 1996 memorandum on the subject of voluntary seismic retrofit in the state, the Senate's Office of Research stated: "Very little voluntary commercial retrofit activity is occurring. Most commercial activity is because of mandatory local programs to strengthen, demolish, or reduce occupancy of unreinforced masonry buildings, or as the result of earthquake damage." That finding belies the fact that professionals involved in earthquake loss reduction (structural engineers, insurance specialists, national economists) all agree that mitigation works, and that cost-effective means exist by which the losses can be reduced. State-mandated programs, such as the Field Act for public schools and the Hospital Act for private hospitals, have proved their value in loss reduction.

Major corporations and institutions are moving toward mitigation actions that involve seismic retrofit of existing facilities and higher performance standards for new facilities. These actions are motivated by the need to ensure protection of property, continuance of operations, and greater levels of life safety.

Encouraging cost-effective earthquake loss reduction efforts is good public policy. Effective mitigation requires three elements: 1) creating cost-effective design and construction solutions; 2) setting priorities; and 3) committing the resources necessary. The design and construction solutions are available; priorities will vary with each of the entities and are well within their control; however, committing the resources is a stumbling block. The key to encouraging sustained, voluntary mitigation efforts lies in incentives that stimulate the private sector to take action. Many public and private entities have already initiated earthquake mitigation actions (as indicated in the following examples), and more will do so in the future. The movement has begun. But much more needs to be done if we are to reduce the losses and speed recovery.

Making It Happen

Several examples help to illustrate the movement toward earthquake loss reduction. The examples have been selected to show a wide variety of approaches. Together they represent a broad cross section of responses to commercial and residential needs for earthquake preparedness.

Walt Disney Company is an example of a major private entertainment corporation concerned for employee and visitor safety and for continued operation. Its analysis and decision were driven primarily by fear of potential loss on a worldwide scale if a crisis-management plan was not implemented.

Pacific Gas and Electric is an example of a major publicly owned utility company that has a significant concern for continued operation. Employee safety was considered first and deemed to be adequately provided for in most existing structures. However, vulnerability to loss of operations was considered unacceptable and was the driving factor in the large scope of its seismic retrofit program.

Rockwell International, now part of Boeing North American, is an example of a major private

aeronautics corporation concerned for the safety of employees and visitors and for continued operation. Rockwell's analysis and decision were driven primarily by the need for continued operation.

Mitigating Housing Losses is a summation of the cost impact on residential housing caused by the Northridge earthquake. The example focuses on the vulnerability of the existing housing stock and the potential displacement of thousands of residents. The analysis argues for taking positive steps toward reducing potential losses within highly damage-prone seismic areas.

City of Los Angeles Unreinforced Masonry (URM) Buildings is an example of local government taking positive steps toward reducing potential losses within a highly damage-prone seismic area. The concern was focused on the vulnerability of the existing URM building stock and the potential risk to life safety.

California Highway Bridges describes a retrofit program that demonstrates a major commitment to seismic safety. The concern was focused on the vulnerability of bridges and their possible collapse during earthquakes.

Conclusion

Recognizing the magnitude of economic loss caused by property damage and operational disruption is becoming the deciding factor in earthquake mitigation throughout California. The economy of the state cannot withstand repeated Loma Prieta or Northridge disasters. The benefits of earthquake loss reduction far outweigh the costs.

Walt Disney Company

Program

The *Walt Disney Company Crisis Management Plan* aims to prevent loss of life and reduce the impact to the business units in the event of a natural or man-made disaster. The plan is designed to carry out this mission by meeting the following objectives:

- Identify controls designed to minimize the potential for a crisis to occur.
- Establish a crisis response organization to perform specific functions before, during, and after a crisis.
- Direct recovery methods for using resources on hand and for obtaining necessary resources during and after a crisis.
- Provide recognizable resumption procedures for moving from normal operation into and out of the crisis.

Issues

Because the Burbank facility of The Walt Disney Company is a corporate and creative hub for the worldwide corporation, it is imperative that there be no loss of continuity or interruption in service that would have a range of impacts on the organization.

Process

Considering the costs of the potential losses at its studio and other facilities, Disney decided to implement a plan that was adequate for the corresponding exposure. Disney realized that, in fact, no down time was acceptable. In essence, Disney assessed the risk, determined that the company wanted to be functional immediately following a disaster, and established a prevention/response/recovery plan to meet that goal.

Decision

The size and growth of the company created a focus on the issues of crisis management with emphasis on the protection of people and company assets. This effort is being spearheaded by a combination of operations and human resources management. Listed below are examples of what the company's current management has done to meet the demands:

- Inititated California Specialized Training Institute to test and train its personnel
- Developed internal training programs to constantly remind all employees of the need to be prepared
- Adapted the Standardized Emergency Management System model to fit Disney's particular needs
- Utilized ATC-20 to identify structural and nonstructural hazards to mitigate

Result

The Walt Disney Company facilities in the Burbank area survived the Northridge earthquake with minor disruption to its operations. Disney is confident the business units are prepared to ride out moderate earthquakes with little or no downtime.

Pacific Gas and Electric (PG&E)

Program

PG&E is the nation's largest investor-owned gas and electric utility. In 1985, the company established a geosciences department to evaluate all its corporate facilities for earthquake hazard and risk.

Issues

PG&E's corporate headquarters is located in the financial district of San Francisco, where at least five active fault segments of the San Andreas and Hayward fault systems have the potential for releasing magnitude-7-or-larger earthquakes in the near future. In 1989, the magnitude 7.1 Loma Prieta earthquake occurred along the Santa Cruz Mountains segment. As a result, there is a 67-percent aggregate probability of a magnitude-7-or-larger earthquake occurring on the remaining four fault segments in the next 30 years.

Some of PG&E's older buildings experienced damage during the Loma Prieta earthquake. The adequacy of the existing building code for seismic retrofit was reconsidered, and PG&E concluded that the existing minimum life-safety code was unacceptable.

Process

Using realistic earthquake scenarios, PG&E began to evaluate its gas and electric system facilities, buildings, power plants, and dams. Earthquake improvements were prioritized on the bases of a facility's life safety and ability to serve customer and community needs following the type of earthquake specified. Some buildings and facilities have been or are in the process of being replaced, upgraded, retrofitted, or abandoned.

Decision

PG&E adopted a much higher earthquake performance (functional) standard for its essential buildings and facilities. It concluded that having a higher earthquake performance standard is prudent because 1) it is consistent with or exceeds the recommended state of practice proposed by the California Seismic Safety Commission; 2) it minimizes earthquake risk to employees, users of the buildings, and the general public; 3) it enhances PG&E's ability to serve the community, especially during the emergency response after a destructive earthquake; and 4) it minimizes the potential for significant asset and revenue loss.

Result

PG&E has a priority-based Earthquake Risk Management Program that is systematically and substantially improving the earthquake performance of its gas and electric systems and essential facilities. During the period 1985 to date, PG&E has spent more than $500 million on seismic upgrades of its buildings, dams, power plants, and gas and electric systems. With the likely prospect of damaging earthquakes in central and northern California, PG&E facilities will perform much more reliably than they would without the upgrades. Having such systems and facilities on-line during an earthquake will reduce losses and serve a vital function during the emergency response period, significantly contributing to a speedy recovery. In 1994, at a joint earthquake conference of the Earthquake Engineering Research Institute and the Seismological Society of America, the Earthquake Safety Foundation awarded PG&E the Alfred E. Alquist Award for PG&E's achievements in improved seismic safety and public service to California.

Rockwell International

Program

Rockwell's Southern California Seismic Engineering Program carries out the corporation's commitment to assess life safety and business interruption needs if an earthquake occurs at its facilities. Rockwell modified 39 buildings as part of its loss reduction program. These buildings were transferred to Boeing North American, Inc., as part of Boeing's acquisition of Rockwell's aerospace and defense businesses. The actions described below were conducted under Rockwell's ownership.

Issues

Rockwell was concerned about several life safety and operational needs: For the most critical buildings, there was to be no major damage, partial collapse, environmental damage, or life-threatening conditions. Structural and nonstructural damage was to be repairable within days, preferably avoiding even a limited partial shutdown of operations.

Process

First, Rockwell established its corporate policy. Based on that policy, it established criteria for damage assessment and loss risk that were appropriate for each business element. Each building function was assigned to one of four *importance* categories. In the Very High Importance category were buildings in which loss of use would have a major impact on a division's ability to operate or on a key program.

The program used three ground motion scenarios at each site: lower level earthquake (LLE) with a return period of 75 years; upper level earthquake (ULE) with a return period of 475 years; and maximum credible earthquake (MCE) as the most damaging event that a site may experience.

The program then created a matrix of performance criteria for each combination of building category and ground motion level. For a given earthquake, the criteria were stricter for higher importance buildings than for less important ones. Also, for each category, the criteria were strictest for the lower level earthquake and least strict for the maximum credible earthquake.

Result

As of March 1996, Rockwell had spent $44 million to modify 39 buildings to meet the performance criteria. More than $25 million of that amount was devoted to three buildings in Seal Beach, including Building 80, a 10-story, super-computer facility, the first building in the world to have a seismic isolation system installed midheight in existing columns. Because of its importance and its proximity to the Newport-Inglewood Fault, Rockwell needed to make sure that Building 80 could survive a magnitude-7 earthquake without having to be shut down.

Rockwell is satisfied that its buildings will perform as expected in a strong earthquake. Rockwell continues to pursue plans for seismic loss reduction at other facilities.

Mitigating Housing Losses

Because the great majority of California's population lives within 20 miles of a major earthquake fault, California must take the initiative to reduce the personal, social, and economic losses that result from earthquakes.

Issues

Northridge was not an unusual event. In every recent disaster except Loma Prieta, residential damage has constituted more than 50 percent of the total losses. Approximately $12 billion was paid out by insurance companies and government agencies, primarily to single-family home owners, for damage repairs caused by the Northridge earthquake. This amount does not include payments made by individuals or private lenders for repairs to uninsured homes, apartments, and condominiums that are estimated to total an additional $20 billion. Twenty thousand units had to be vacated, and federal assistance was provided to 130,000 households for short- and long-term rental subsidies.

Most owners of damaged apartments did not have earthquake insurance. Government loans and HUD allocations reached less than half of the significantly damaged multifamily units, and owners had to rely on private financing for repairs. By contrast, more than 500,000 owners of single-family homes received insurance payments and/or government assistance for nonstructural and minor, but costly, repairs. The capacity to rehouse victims during recovery depends on the availability of undamaged housing at comparable rents, and the capacity to repair and rebuild housing depends on the availability of private financing.

Process

The federal government is actively looking for mechanisms to reduce postdisaster expenditures, and the insurance industry has worked with high-hazard states to reduce their exposure to disaster losses through state-managed insurance pools. Two basic avenues for mitigating the impact of earthquakes are available: governmental intervention (a commitment to more broadly available financing for disaster repairs) and a targeted program aimed at loss reduction.

California has created its own California Earthquake Authority (CEA). However, there are initial concerns about cost and coverage. For example, when another earthquake loss occurs in the Northridge area, 40 percent of the homeowners who made damage claims after the 1995 Northridge earthquake will be ineligible because of the CEA's high (15 percent) deductible. In addition, coverage restrictions will reduce the total residential insurance claims paid to about $4 billion, less than half the amount actually paid after the 1995 quake.

Although the creation of additional state and federal disaster loan programs is unlikely, it is possible for the state to help create a healthy and competitive disaster insurance industry. In addition, effective mitigation policies will require financial incentives, such as tax credits, insurance discounts, or mortgage credits.

Reduced losses from earthquakes can be achieved only if the state can 1) create a functioning, mostly private insurance system through which citizens can protect themselves from hazards; 2) take a stand for more intelligent use of federal funds; 3) establish a basis for smarter and smaller subsidies to private citizens for recovery; and 4) provide incentives that encourage cost-saving mitigation measures.

Los Angeles Unreinforced Masonry Buildings

The City of Los Angeles has more unreinforced masonry (URM) buildings than any other city in California. A 1979 inventory counted about 8,000 URM-bearing-wall buildings, all constructed before 1934 and located mainly in economically depressed neighborhoods.

Issues

Strong ground motion causes URM walls to shatter. The building collapses and bricks shower into the street. Both passersby and occupants are at risk. Seismic retrofit can prevent death and injury by tying the building together. However, the cost to the owner is enough to arouse opposition, especially because seismic retrofit alone does not increase the value of a URM building.

In 1975, Los Angeles adopted the seismic safety element of its general plan. It recommended that hazard abatement start with the most vulnerable buildings. In 1976, the Department of Building and Safety proposed an ordinance requiring retrofit or demolition of URM-bearing-wall buildings. In 1978 a city study estimated that the program would reduce city deaths from 8,500 to 1,500 and reduce serious injuries from 34,000 to 8,000 in the event of a catastrophic earthquake.

Process

The debate in Los Angeles centered on the cost of retrofit. Owners of unreinforced masonry buildings feared that rehabilitation up to current *Uniform Building Code* standards would cost 70 percent of replacement. Compromise standards were developed that could achieve substantial life safety at lower cost. Finally, experimental retrofits were performed in 1980 to demonstrate the cost of the new standards: $5.65 to $11.00 ($11 to $22 in current dollars) per square foot. These amounts were lower than most people expected.

The issue was kept alive for six years because the risk posed by URMs was unacceptable. The revelation that retrofit could be done at relatively low cost was the turning point in overcoming opposition to the proposed ordinance. The low cost was made possible by using standards that reduced most of the risk at a fraction of the cost of complying with current code standards.

Decision

The city council passed an ordinance in February 1981. The lateral force standards reflected those in effect from 1940 to 1960. Building owners were given three years to comply after official notification. After the Mexico City earthquake of 1985, the ordinance was amended to speed up the mitigation program.

Result

As of March 1997, 94 percent of the URM buildings were in compliance. Of the buildings identified in the 1979 inventory, 5,817 had been strengthened and 1,736 demolished.

The Whittier Narrows earthquake in 1987 provided the first test of the efficacy of the program. Retrofitted URMs suffered significantly less damage than URMs that had not yet been retrofitted. The program was nearly completed in time for the Northridge earthquake. Some of the retrofitted buildings suffered damage, but no one died from the collapse of this type of building.

California Highway Bridges

Program

Approximately 12,000 bridges in the California state highway system are operated and maintained by the California Department of Transportation (Caltrans), and about the same number are controlled by local agencies. Many of these bridges were constructed prior to 1971 when seismic design codes were overhauled as a result of the 1971 Sylmar earthquake.

Issues

Prior to 1971, highway bridge design lacked the analysis and detail necessary to provide adequate seismic safety for many areas where strong ground motions were expected. This vulnerability became dramatically evident as bridges collapsed during the Sylmar quake. For bridges yet to be constructed, the lessons learned at Sylmar led to revisions in the design code and new research to improve the performance of highway bridges during earthquakes. In addition, the method of modeling forces in the design process was improved.

However, a retrofit program was needed to address bridges already in place. In particular, hinges in the superstructure needed investigation and possible retrofit; columns and footings in the substructure required the same scrutiny and possible correction. Hinges were vulnerable because the shaking during earthquakes could cause them to unseat, leading to collapse. Many columns lacked the confining reinforcement necessary to prevent severe damage, and footings could support only downward loads, not the uplift which can happen during earthquakes.

Process

Following the Sylmar earthquake, Caltrans began a program to add restraining elements to superstructure hinges that would prevent the unseating potential and avert collapse. Once this program was completed, the retrofit effort shifted to the substructure—columns and footings. The typical column retrofit involved adding a steel casing around the column to provide confinement and help maintain the stability of the column during and after earthquakes. Piles were added around footings and strengthened further with concrete and reinforcement.

Bridges were prioritized in the retrofit program in accordance with their proximity to fault(s), the maximum credible earthquake for the contributing fault(s), the year the bridge was constructed, the structural details, and the type of construction of the bridge. The site data and structural details were reviewed by teams of engineers to decide if the bridges should be further analyzed for possible retrofitting. These screening reviews identified 2,194 state-owned bridges and 700 locally owned bridges that needed retrofits.

Result

Following the Loma Prieta earthquake of 1989, seismic retrofit was Caltrans's top priority. By August 1997, 1,690 state-owned bridges had been retrofitted, and 450 had retrofits under construction. The remaining 62 bridges were ready to have construction begin or were in the design process. By mid-1997, $1.8 billion had been committed to the retrofit program with an additional $2 billion planned for toll bridge retrofits. Local agency bridges also had retrofits being designed.

The 1994 Northridge earthquake provided a test of retrofitted bridges. For example, a retrofitted bridge supporting the Santa Monica Freeway came through in good condition, while a nearby unretrofitted portion collapsed.

The Successes

Past versions of California's earthquake loss reduction plans have spurred actions to save lives, prevent damage, and reduce disruption associated with earthquakes. The plans included definitive initiatives for implementation by various state agencies. In many cases, the agencies took seriously the milestones of the initiatives and carried them out according to the recommended schedule and available funding. In some cases an intervening earthquake exposed problems that gave the initiatives fresh importance.

The fact that the initiatives spurred action is of itself a success; taken as a group, the initiatives have moved the state closer to its goal. The following table provides at a glance the results of initiatives that have had the most impact. Summaries of key elements of the initiative titles preceded by an asterisk (*) begin on page 43. These initiatives from the state's 1986 and 1992 loss reduction plans were of primary importance in the achievement of California's goals and objectives.

Initiative	Action taken	Intended result
Establish Seismic Evaluation and Retrofit Building Standards	Tilt-up and residential retrofit standards. Evolving nonductile concrete retrofit methods.	Collapse of buildings averted. Lives saved in future earthquakes.
*Improve Safety of Older Hospital Buildings	A program to upgrade seismic performance of acute care hospitals.	Hospitals functioning after future earthquakes.
Improve Safety of Homes	*Home Owner's Guide to Earthquake Safety.*	Disclosure of hazard at time of sale of property.
*Improve Safety of Mobile Homes	Standards for tie-downs. Regulations adopted.	Reduced property loss after earthquakes.
Conserve Historic Buildings	Program to update *State Historical Building Code.*	Preserved historical resources for future generations and reduced property loss.
*Improve Earthquake Performance of Power and Gas Systems	Interutility Seismic Working Group mitigates significant seismic vulnerabilities; improves earthquake preparedness and response procedures.	Reduced utility outages and improved safety and service restoration after an earthquake.
Improve Earthquake Performance of Offshore Oil Facilities	Standards adopted, platforms recertified by State Lands Commission.	Reduced risk of oil spill after an earthquake.

Initiative	Action taken	Intended result
Improve Seismic Standards for New Construction	International Conference of Building Officials code provisions.	Reduced property damage after earthquakes.
*Map Geologic Hazards	Seismic Hazard Mapping Program.	Informed land-use planning.
*Improve Seismic Safety Training of Building Professionals	Certification and continuing education of building officials, plan reviewers, and inspectors.	Enhanced building code enforcement by better-trained personnel.
*Improve Emergency Communications System	Operational Area Satellite Information System.	Reliable communications between government agencies during disasters.
Improve Emergency Management System	Standardized Emergency Management System.	Coordination of emergency response.
*Improve Mutual Aid	Mutual aid extended to more kinds of services.	Reduced disruption after a disaster.
Improve Medical Mutual Aid	Eight medical teams ready for deployment in disasters.	Better treatment of casualties.
*Improve Shelter Planning	Identified shelters in advance, trained shelter managers.	Quick opening of emergency shelters. Some long-term shelters.
Improve Professional Qualifications of Emergency Managers	Certification programs developed by the University of California and the National Coordinating Council on Emergency Management.	Better qualified emergency managers.
*Implement Recovery Guidelines	Helped local jurisdictions analyze recovery process.	Faster, more thorough recovery from a disaster.
Implement an Earthquake Research Plan	Pacific Earthquake Engineering Research coming to California.	Better earthquake engineering.
*Establish a Coordinated Earthquake Information Strategy	Programs for knowledge transfer and education outreach.	Better informed public resulting in fewer deaths, less disruption.
*Identify and Reduce Tsunami Hazards	Tsunami Hazard Mitigation Federal/State Working Group.	Lives saved after tsunami caused by offshore earthquake.
*Improve Transportation Structures	Caltrans Bridge Retrofit and Research Programs.	Fewer bridge collapses after an earthquake.
*Strengthen Strong Motion Instrument Program (SMIP)	Increased funding for SMIP.	Useful information for constructing earthquake-resistant buildings.

Improve Safety of Older Hospital Buildings

Action

Revised law established a program to upgrade seismic performance of acute care hospitals.

Result

Hospital functionality after future earthquakes

Comment

The Northridge earthquake demonstrated that hospitals built before 1973 did not fare as well as hospitals constructed under the Hospital Seismic Safety Act. Because three-quarters of the state's acute care hospitals predate 1973, this evidence revealed a widespread problem. In 1994, the Seismic Safety Commission sponsored the legislation (SB 1953, Alquist) to require seismic retrofit of pre-1973 hospitals.
In 1996 the Office of Statewide Health Planning and Development developed:

- Definitions of earthquake performance categories for new and existing hospitals,
- Rapid seismic evaluation procedures for hospital owners, and
- Seismic standards for retrofit design, construction, and field review of hospital systems.

The amended Hospital Seismic Safety Act requires that owners of all general acute care hospitals prepare a comprehensive plan and compliance schedule by the year 2000. By the year 2008, general-acute-care-hospital buildings that pose collapse hazards may be used only for nonacute-care-hospital purposes. By the year 2030, all acute-care-hospital buildings that are not in substantial compliance with the Hospital Seismic Safety Act must be retrofitted, demolished, replaced, or changed to nonhospital use.

Improve Safety of Mobile Homes

Action

The Department of Housing and Community Development (HCD) adopted regulations for earthquake-resistant mobile homes.

Result

Reduced property loss after an earthquake

Comment

The Department of Housing and Community Development is responsible for certifying commercial mobile home installations for earthquake resistance. Mobile homes are vulnerable to earthquake damage because their usual means of structural support do not withstand strong earth motion.

In the early 1990s, HCD performed a study to evaluate the safety of various types of support systems and utility connections for mobile homes. After the Northridge earthquake, a law passed in 1994 (SB 750) paved the way to get new regulations adopted. The law requires mechanical connections between piers and the structure, as well as tie-downs. New mobile homes have much greater resistance to earthquake shaking than those installed on conventional supports.

Improve Earthquake Performance of Power and Gas Systems

Action

Gas and electric utilities formed an ad hoc Inter-Utility Seismic Working Group in 1988 to support utilities in upgrading equipment and procedures.

Result

Reduced utility outages and faster service restoration after an earthquake

Comment

The Group developed its comprehensive *Policy on Acceptable Levels of Earthquake Risk*, which the Public Utilities Commission (PUC) received on February 8, 1994. The *Policy* states that each California gas and electric utility system shall withstand earthquakes to provide reasonable protection of life, to limit damage to property, and to provide for resumption of utility system functions in a reasonable and timely manner. Each utility is required to create its own policy implementation plan.

The Group established common criteria and procedures for emergency response to facilitate timely restoration of service and repair or replacement of earthquake-damaged systems. For example, the group wrote a set of criteria for use as a checklist of pre-earthquake preparations and postearthquake response and recovery measures. Both the PUC and the utilities themselves measured progress by explicit reference to the milestones of this initiative.

The utilities apply the *Policy* in selecting procedures for seismic mitigation of existing facilities. For new utility facilities, current codes and standards provide acceptable performance. The American Society of Civil Engineers and the Institute of Electrical and Electronics Engineers have developed national seismic guidelines for substation structures and components.

Map Geologic Hazards

Action

The California Department of Conservation, Division of Mines and Geology (CDMG), is carrying out the Seismic Hazard Mapping Program.

Result

Improved knowledge of seismic hazard locations and better land-use planning

Comment

The Seismic Hazards Mapping Act requires the State Geologist to identify and map seismic hazards for use by cities and counties in preparation of the safety elements of their general plans. New projects undertaken within seismic hazard zones will require geotechnical studies to identify appropriate mitigation measures. Also, sellers of real property located within these zones must disclose this information to potential buyers.

CDMG uses a standardized method of hazard assessment to evaluate hazard potential consistently for the entire state. Each map covers approximately 60 square miles and is scaled to show hazard zones street by street.

After the Northridge earthquake, CDMG pointed out the initiative in *California at Risk.* Thus, CDMG was able to accelerate the program with federal disaster relief funds from FEMA through the Governor's Office of Emergency Services. As much as $15 million has been earmarked for seismic hazard mapping in southern California counties affected by the 1994 Northridge earthquake. CDMG is using the funding to produce 38 maps by mid-1998. Five of the maps have already been released and another ten are out for review.

Improve Seismic Safety Training of Building Professionals

Action

A new law requires certification and continuing education of building officials, plan reviewers, and construction inspectors.

Result

Enhanced construction quality control through better building code enforcement by better-trained personnel, resulting in reduced property damage after earthquakes

Comment

One of the key lessons of the Northridge earthquake was that a significant portion of damage resulted from incorrect construction practices and inadequate construction inspections. Better code enforcement could have averted much of the quake damage.

In 1995 the California Building Industry Association and California Building Officials (CALBO) sponsored legislation that requires building officials, plan reviewers, and construction inspectors to be certified by nationally recognized organizations and to receive continuing education.

The law requires a minimum of 45 hours of continuing education in every three-year period.

Improve Emergency Communications System

Action

The Office of Emergency Services (OES) established a satellite telephone system connecting its centers with the Emergency Operations Centers in the 58 operational areas throughout the state.

Result

Reliable communications among government agencies during disasters

Comment

Following the 1987 Whittier Narrows earthquake, OES could not effectively communicate with southern California locations. The earthquake knocked many telephones off their cradles, and the call volume increased significantly as family and friends attempted to reach each other.

After the Loma Prieta earthquake, the telephone system was saturated off and on for two weeks. Long distance carriers had to cut back the capacity for calls coming in to northern California, including the OES headquarters in Sacramento.

In 1991, OES established the Operational Area Satellite Information System (OASIS), connecting the three OES regions to the Emergency Operations Centers, with selected

critical facilities (the three main seismological laboratories, three Caltrans centers, and eight trailer-mounted units, for example). OASIS has two redundant gateways to the public telephone system, one in Sacramento and the other in Orange County.

Routine use of the system keeps participants in practice. OASIS will play a vital role in emergency communications when a moderate earthquake strikes a rural area or if a major earthquake occurs in an urban area.

Improve Mutual Aid

Action

The Office of Emergency Services established a system that allows local jurisdictions to get timely support from agencies outside the damaged area for governmental service that has been disabled or overextended.

Result

Reduced disruption and improved response after a disaster

Comment

Local jurisdictions have long had mutual aid agreements to provide fire and police augmentation when needed; however, communities affected by major disasters need a multitude of services in addition to fire fighting and law enforcement.

The California Master Mutual Aid Agreement provides a framework of general procedures. OES is implementing the procedures by working out the details that will enable 24 professional and technical groups to help with emergency response and recovery.

After the Northridge earthquake, building inspectors, emergency managers, and volunteer private-sector design professionals participated in the mutual aid effort. Later in 1994, mutual aid agreements expanded to include mental health, water district, and urban search-and-rescue teams. Mutual aid for hazardous-materials spills became official in 1994.

OES has developed standard procedures for using these services. The California Specialized Training Institute, which is operated by OES, offers training on mutual aid.

Improve Shelter Planning

Action

The Department of Social Services (DSS) and the American Red Cross have identified shelters in advance of earthquakes and trained managers to operate them during the disasters.

Result

Better availability of emergency shelters and of long-term shelter

Comment

The Whittier Narrows and Loma Prieta earthquakes demonstrated the need to improve emergency and long-term shelter planning and operation. However, shelters were slow to open because nobody had identified them ahead of time. Some schools

suffered damage, so they could not be used as shelters. Some shelter managers lacked training in how to deal with the diverse population of California.

In partnership with the American Red Cross, DSS is finalizing its work on this initiative and continues to address sheltering needs and training.

- DSS began training county employees as shelter managers and shelter systems officers in 1994. DSS has utilized them successfully during recent disasters.
- The Red Cross has an ongoing program to train local volunteers in shelter management.
- The Welfare Emergency Services Team, using state employees trained as shelter managers, worked in food distribution and other roles in the 1993 floods in the Midwest.
- The Red Cross provides diversity training to all disaster workers to better address the needs of California's diverse population. The 1994 updates to the State Emergency Plan reflect this progress.

Implement Recovery Guidelines

Action

The Office of Emergency Services has helped local jurisdictions analyze the recovery process.

Result

Faster, more thorough recovery from a disaster

Comment

OES has considered recovery-period mutual aid and has arranged for jurisdictions with recent experience to work with those in the beginning stages of recovery. For example, local officials from Watsonville, which had experienced the Loma Prieta earthquake, went to Northridge after the quake there.

OES has completed a resource manual on recovery for local jurisdictions. The California Specialized Training Institute, which is operated by OES, offers a new training course on recovery.

Establish a Coordinated Earthquake Information Strategy

Action

Several programs coordinate information transfer and education.

Result

Better informed public, resulting in fewer deaths and less disruption

Comment

The Southern California Earthquake Center (SCEC) coordinates two innovative programs that target the general public as well as professionals who have specialized roles in disaster mitigation. The Knowledge Transfer Program seeks to identify and meet the knowledge needs of a variety of end users. For example, SCEC has launched a workshop and a continuing education series for the insurance industry.

SCEC's Education Program develops and disseminates educational experiences, materials, and exhibits through creative approaches to teacher enhancement and student activities. This program targets museums and libraries as well as schools.

The Association of Bay Area Governments (ABAG) promotes earthquake awareness in its region. Through publications such as *On Shaky Ground* and *Shaken Awake!*, ABAG informs the public about seismic hazards and their impacts on housing. ABAG also offers a good source of earthquake-related information on its Web site.

The Office of Emergency Services' Earthquake Program provides planning and technical assistance on earthquake-related concerns. Program staff members work with organizations and individuals to address preparedness, hazard mitigation, emergency response, business resumption planning, and recovery from disaster. The staff organize workshops and seminars, undertake public education initiatives, and help guide the earthquake-related projects of many other organizations. OES's coastal region houses a resource center for use by government employees, the public, and researchers. The program also writes, publishes, and disseminates planning documents and other guidelines to assist Californians in preparing for and reducing potential losses in future earthquakes.

Identify and Reduce Tsunami Hazards

Action

California participates in the state/federal tsunami hazard mitigation program.

Result

Lives saved following an offshore earthquake-caused tsunami; better preparedness

Comment

The 1992 Cape Mendocino earthquake generated a tsunami that came ashore between Crescent City and San Francisco. California officials, pointing to the initiative in *California at Risk*, requested federal help.

In 1996, the Tsunami Hazard Mitigation Federal/State Working Group produced the *Tsunami Hazard Mitigation Implementation Plan*. Part of the plan is to deploy tsunami detection buoys that will be able to detect and measure significant Pacific-wide tsunamis within 30 minutes of a generating earthquake. As a result, the false alarm rate for tsunami warnings, historically 75 percent, will drop to near zero.

Three of the plan's recommendations relate to local tsunamis:

- Produce inundation maps (essential to emergency planning);
- Develop hazard mitigation programs incorporating tsunami concerns in land use; and
- Improve seismic networks to provide details of a potential tsunamigenic earthquake within five minutes, in contrast to the hour that it takes today.

Funding became available in 1997 to complete the main elements of the plan within the next three years. For example, OES released the tsunami hazard maps for Humboldt County in 1995.

Improve Transportation Structures

Action

Caltrans accelerated its bridge retrofit program.

Result

Fewer bridge collapses in an earthquake; less disruption of traffic

Comment

After the 1971 San Fernando earthquake, the Department of Transportation established a retrofit program to improve the seismic resistance of state bridges. Phase I, completed in 1989, involved installation of hinge restrainers on 1,300 state bridges.

Phase II of the retrofit program began in 1988, a year before the Loma Prieta earthquake. Funding was increased from $4 million to $16 million per year. This phase focused on retrofit of bridges and improvement of substructures, including abutments and columns, in areas of high seismic activity. After the Loma Prieta earthquake, Caltrans expanded the program to include all state and local bridges and identified 1,039 bridges needing retrofit. Caltrans revised its performance criteria in 1992, increased funding in 1994, and added an additional 1,364 bridges by 1996 to be completed by late 1997.

During the Northridge earthquake, the 114 retrofitted bridges in Los Angeles County performed well. Their survival validated the seismic retrofit procedures.

Strengthen Strong Motion Instrument Program

Action

The California Department of Conservation, Division of Mines and Geology, obtained increased funding for the Strong Motion Instrumentation Program (SMIP).

Result

Better understanding of strong motion and building response leading to more earthquake-resistant construction of future buildings

Comment

CDMG started the Strong Motion Instrumentation Program in 1972, the year after the San Fernando earthquake. SMIP assists engineers in installing, maintaining, and reading instruments located in representative buildings. Earthquake shaking triggers an instrument to record the building's motion. These strong motion records help engineers understand how buildings actually behave during earthquakes. Lessons learned in this fashion help to determine future modifications in codes and identify improvements in earthquake-resistant design.

SMIP receives money from fees collected by local governments for the issuance of building permits. In the early years of the program, the fee was $.07 per $1,000 of construction cost. In the 1986-87 fiscal year, these fees totaled $2.7 million. This amount was not enough to fund the level of activity necessary to instrument all the relevant types of structures statewide. In 1988, legislation increased the fees to $.13 per $1,000 of construction cost. In the 1990-91 fiscal year, the fees brought in $3.8 million.

When the Northridge earthquake struck, SMIP had in place a dense array of instruments. SMIP recovered 193 accelerograms, yielding much useful information about ground shaking and building response.

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